No. 2014-1047

United States Court of Appeals for the Federal Circuit

HITACHI CONSUMER ELECTRONICS CO., LTD.
and HITACHI ADVANCED DIGITAL, INC.,

Plaintiffs-Appellants,

v.

TOP VICTORY ELECTRONICS (TAIWAN) CO., LTD., TPV INTERNATIONAL (USA), INC., ENVISION PERIPHERALS, INC., TOP VICTORY ELECTRONICS (FUJIAN) CO. LTD., TPV ELECTRONICS (FUJIAN) CO. LTD., and TPV TECHNOLOGY LTD.,

Defendants-Appellees.

Appeal from the United States District Court for the Eastern District of Texas in No. 2:10-cv-00260-JRG, Judge J. Rodney Gilstrap.

BRIEF FOR PLAINTIFFS-APPELLANTS HITACHI CONSUMER ELECTRONICS CO., LTD AND HITACHI ADVANCED DIGITAL, INC.

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ADDENDUM UNDER FED. R. APP. P. 28(f) – ASSERTED CLAIMS OF '375, '310, AND '243 PATENTS

'375 Patent:

25. A digital information receiving apparatus, comprising;

a receiver configured to receive digital information transmitted in electric wave form from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate the digital information received by the receiver;

an error corrector configured to correct an error of the digital information demodulated by the demodulator based on the error correction information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

a first expander configured to bit-expand the video information of the digital information error corrected by the error corrector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of the digital information error corrected by the error corrector in accordance with a second expansion method corresponding to the second compression method.

26. A digital information receiving apparatus, according to claim **25,** wherein the first compression method utilizes a discrete cosine transform.

29. A digital information receiving apparatus, comprising;

a receiver configured to receive digital information transmitted in electric wave form from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate a digital information which is previously received by the receiver;

an error corrector configured to correct an error of a digital information which is previously demodulated by the demodulator based on the error correction information, the error being the error which occurs in the transmission path having no recording process of a digital information therein;

a first expander configured to bit-expand the video information of a digital information which is previously error corrected by the error corrector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of a digital information which is previously error corrected by the error corrector in accordance with a second expansion method corresponding to the second compression method.

30. A digital information receiving apparatus, according to claim **29,** wherein the first compression method utilizes a discrete cosine transform.

'310 Patent:

6. An apparatus for processing a transmitted digital signal including at least one of a video signal and an audio signal, comprising:

a receiver which receives the transmitted digital signal, wherein the transmitted digital signal includes a video signal bit-compressed by a first compression method, an audio signal bit-compressed by a second compression method, and an error correction signal added commonly to both the video signal and the audio signal;

a demodulator which demodulates the digital signal received by the receiver;

an error corrector which corrects an error of the digital signal demodulated by the demodulator based on the error correction signal;

a first expander which bit-expands the video signal of the digital signal corrected by the error corrector in accordance with the first compression method; and

a second expander which bit-expands the audio signal of the digital signal corrected by the error corrector in accordance with the second compression method.

7. The apparatus according to claim **6,** wherein the first compression method utilizes a discrete cosine transform.

'243 Patent:

1. A digital broadcast receiver unit for receiving a digital multiplexed signal stream having multiplexed signals commonly encoded using a same encoding/decoding standard, said multiplexed signals including video signals corresponding to a plurality of different video signal formats, and isolating and reproducing at least one video signal, said unit comprising:

an isolator to isolate one video signal from a received said digital multiplexed signal;

a decoder to decode the video signal from said isolator according to said encoding/decoding standard;

a plurality of video processor sections, with respective video processor sections providing video processing according to a different video signal format of said plurality of different video signal formats; and

a controller using information from the received said digital multiplexed signal to determine a video signal format of said video signal from said decoder, and selecting one video processor section of said video processor sections to perform video processing of said video signal according to a determined video signal format thereof.

4. A unit as claimed in claim **1,** wherein said plurality of video processor sections is more specifically provided via at least one of a common application specific integrated circuit (ASIC) and a common microprocessor adapted to selectively perform processing according to any of said plurality of video processor sections.

5. A unit as claimed in claim **4,** wherein said selecting by said controller is more specifically performed by said controller selectively performing processing with respect to said one video processor section while not performing processing with respect to other ones of said video processor sections.

CERTIFICATE OF INTEREST

Counsel for the appellants Hitachi Consumer Electronics Co., Ltd. and Hitachi Advanced Digital, Inc. certifies the following:

1. The full name of every party or amicus represented by me is:

Hitachi Consumer Electronics Co., Ltd. and Hitachi Advanced Digital, Inc.

2. The name of the real party in interest (if the party named in the caption is not the real party in interest) represented by me is:

In addition to Hitachi Consumer Electronics Co., Ltd. and Hitachi Advanced Digital, Inc., Hitachi Maxell, Ltd. has an interest as assignee of the patents-in-suit.

3. All parent corporations and any publicly held companies that own 10% or more of the stock of the party or amicus curiae represented by me are:

Hitachi Consumer Electronics Co., Ltd., Hitachi Advanced Digital, Inc., and Hitachi Maxell, Ltd. are private corporations duly incorporated under the laws of Japan and are each owned 100% by Hitachi Ltd., a Japanese public corporation that is listed on the Tokyo and Nagoya stock exchanges in Japan. No single entity owns 10% or more of Hitachi, Ltd.'s stock.

4. The names of all law firms and the partners or associates that appeared for the party or amicus now represented by me in the trial court or are expected to appear in this court are:

Dechert LLP: Jeffrey B. Plies, Daniel B. Epstein, George W. Webb, III*, James Ragon, Jeffrey S. Edwards, Joshua C. Walsh-Benson*, Martin J. Black, Michael A. Fisher*, Robert W. Ashbrook, Jr., Sharon K. Gagliardi, Stephen R. Dartt, Teri-Lynn A. Evans, Tina P. Soriano*, Vincent A. Gallo, Gretchen S. Sween*

Ireland, Carroll & Kelley, P.C.: James P. Kelley, Otis W. Carroll, Jr.

Morrison & Foerster LLP: Deanne E. Maynard, A. Max Olson, Marc A. Hearron, Jessica E. Palmer

[Continued on next page.]

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* *No longer with firm*

Dated: January 27, 2014 s/ Deanne E. Maynard

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STATEMENT OF RELATED CASES

This action has not previously been before this or any other appellate court. Counsel for plaintiffs-appellants Hitachi Consumer Electronics Co., Ltd. and Hitachi Advanced Digital, Inc. (collectively, "Hitachi") are unaware of any pending case that will affect or be affected directly by this Court's decision.

JURISDICTIONAL STATEMENT

The district court had jurisdiction under 28 U.S.C. §§ 1331 and 1338. Final judgment was entered on September 19, 2013. Plaintiffs-appellants appealed on October 17, 2013. This Court has jurisdiction under 28 U.S.C. § 1295(a).

STATEMENT OF THE ISSUES

1. Whether Hitachi was entitled to judgment of non-invalidity of U.S. Patent Nos. 8,009,375 ("'375 patent") and 7,286,310 ("'310 patent") as a matter of law (or at least a new trial) because there was no substantial evidence that the DigiCipher document was prior art.

2. If the invalidity judgment is set aside, whether judgment of infringement as a matter of law (or a new trial) should be ordered as to the asserted claims of the '375 and '310 patents because the accused televisions have all the claimed elements.

3. Whether judgment of infringement as a matter of law (or a new trial) should be ordered as to claims 4 and 5 of U.S. Patent No. 6,549,243 ("'243 patent") because the accused products have a plurality of video processor sections.

4. If the invalidity judgment is set aside but judgment of infringement as a matter of law is not ordered, whether Hitachi is entitled to a new trial on infringement of the '375, '310, and '243 patents and U.S. Patent No. 5,502,497

("'497 patent") because TPV relied on the DigiCipher document to show non-infringement even though that document never should have been admitted.

INTRODUCTION

Hitachi brought this suit for infringement of certain patents that are fundamental to modern digital televisions, including the '243, '310, '375, and '497 patents. The patents are directed to aspects of receiving and processing over-the-air digital television broadcasts. Hitachi alleged that LCD televisions manufactured by defendants-appellees (collectively, "TPV") and sold in the United States infringe the asserted claims.

TPV responded by contending that the asserted claims of the '375 and '310 claims are invalid as anticipated and obvious. TPV's invalidity case depended on a single piece of alleged prior art, the so-called "DigiCipher" document. That document, an unpublished document created by General Instrument, bore a date only weeks before the July 20, 1990 priority date. TPV had to prove by clear and convincing evidence that this internal company document was publicly available before the priority date. TPV fell well short of meeting this heavy burden. Although TPV repeatedly assured the district court that a former General Instrument employee would establish public accessibility, when that employee took the stand, he admitted: "I don't know when this document was given to the public, so to speak," and "I can only, you know, speculate." A8822. No other

evidence established the document's public accessibility before the priority date. No reasonable jury could have found that the DigiCipher document was prior art under any standard, much less by clear and convincing evidence. The district court should have granted judgment of non-invalidity as a matter of law.

As to infringement, there were no disputes at trial about how the accused products operate. Indeed, TPV's infringement experts acknowledged that the accused television receivers contain all the elements recited in the claims. TPV thus sought to avoid infringement in two ways: first, by adding limitations to the claims that are not present, and second, by pointing to elements in the accused devices not covered by the claims, even though the claims are open-ended, "comprising" claims. But pointing to unrequired features and limitations is legally insufficient to sustain the verdict. Because the undisputed evidence established infringement under the claims as construed, judgment of infringement as a matter of law should be ordered.

At the very least, a new trial is warranted on infringement because of the erroneous admission of the DigiCipher document. TPV not only used the DigiCipher document for invalidity but also argued that the DigiCipher document "went directly to issues of non-infringement." A9548. But the DigiCipher document never should have been admitted, and its erroneous admission tainted the entire trial. During deliberations, the jury asked only one question: it

requested the DigiCipher document. A9267. Because there is a substantial risk that Hitachi was prejudiced by the document's erroneous admission, a new trial on infringement is required if judgment of infringement as a matter of law is not ordered.

STATEMENT OF THE CASE

A. Factual Background

1. The parties

Hitachi is a global electronics company, headquartered in Tokyo, Japan. A7933-A7951 at A7934 (Satoshi Matsuo, Manager, IP Business Development, Hitachi). Hitachi manufactures and sells information and communication systems, consumer electronics, and other electronic products. A7939-A7940 (Matsuo). Hitachi manufactured televisions for many years and still sells "Hitachi" brand televisions manufactured by others, including TPV. A7945 (Matsuo). Hitachi invests approximately $4 billion annually in research and development and ranks in the top five patentees in U.S. patents issued. A7939-A7943 (Matsuo).

TPV is an international electronics-manufacturing conglomerate, headed by TPV Technology Ltd. (a Hong Kong company), with its principal operations in Taiwan. A7988 (Matsuo); A8739-A8744 at A8741 (Mondy Houng, Senior Vice President, Finance, TPV); A9172. TPV manufactures televisions, computer monitors, and other electronics. A8743 (Houng). TPV is an original equipment

manufacturer ("OEM"), meaning that it makes products for branded companies. A7946 (Matsuo). TPV entered the flat-panel television business in 2002 and is now the world's largest OEM of televisions. A7948-A7950 (Matsuo); A8744 (Houng).

2. Technological background

In the bygone era of analog television, each broadcast signal could contain only a single television channel. A8117-A8157, A8169-A8198 at A8127-A8128 (Dr. Harley Myler, Hitachi's expert on '243 patent). Broadcasts were highly susceptible to signal interference from weather or obstacles in the signal path. A8230-A8300, A8305-A8314, A8323-A8328, A8366-A8393 at A8253-A8254 (Jeffrey Hamilton, Hitachi's expert on '375 and '310 patents); A8874-A8936, A8949-A9008 at A8899-A8900 (Anthony Wechselberger, TPV's expert on '375 and '310 patents).

The FCC now requires all television broadcasts to be transmitted digitally, according to a standard developed by the Advanced Television Systems Committee ("ATSC"). A8152 (Myler); A8261-A8262 (Hamilton); A11066-A11201. Since 2007, federal law also has required that all televisions sold in the United States be able to receive ATSC-compliant signals. A8262-A8263 (Hamilton).

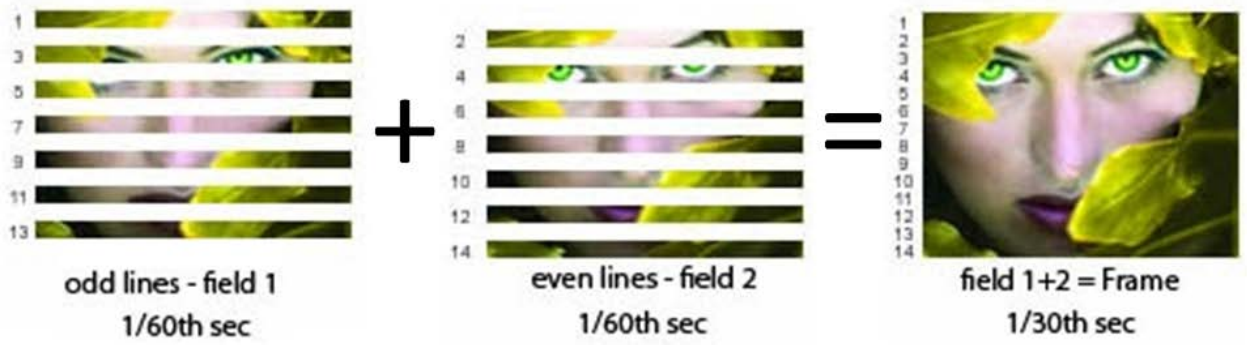
The advent of digital broadcasting brought about significant improvements in the television-viewing experience. A8128 (Myler). Digital signals are "multiplexed," meaning that broadcasters can transmit multiple programs over a single signal. A256(col.1:14-15); A8128-A8130, A8140 (Myler); A8825-A8871 at A8839-A8841 (Dr. Clifford Reader, TPV's expert on '243 patent). For example, an ABC affiliate broadcasting on channel 3 may broadcast, using a single signal, its flagship station on a main channel (channel 3-1), weather programming on a sub-channel (channel 3-2), and a 24-hour news broadcast on another sub-channel (channel 3-3). A8129-A8130 (Myler); A8263 (Hamilton); A8839-A8840 (Reader).

Television display quality also improved significantly. Modern televisions are "high definition" televisions ("HDTV"), with better-quality displays. A8263 (Hamilton). Because of bandwidth limitations, however, broadcasters do not transmit all sub-channels in HDTV quality. Broadcasters typically transmit their flagship channel in the highest-quality format and other programming in lower quality. A8135-A8141 (Myler). Televisions therefore must be able to process and display pictures according to multiple formats. A8141-A8142 (Myler).

Video formats are designated with a number and with either the letter "p" or "i." A8130-A8131 (Myler). The number represents the number of horizontal scan lines (i.e., rows of pixels) in each frame of the image. A8130-A8133 (Myler). A

higher number provides greater resolution. A8133 (Myler). The "p" or "i" represents whether the horizontal scan lines are transmitted progressively or interlaced. A8130-A8131 (Myler). Standard-definition television in the United States is broadcast in 480i, and HDTV is broadcast in 720p and 1080i. A8140-A8141 (Myler); A8848 (Reader).

A signal is "progressive" when the horizontal lines of a picture are sent sequentially. A8133 (Myler). A signal is "interlaced" when only every other horizontal line of the picture is sent. A8133-A8134 (Myler). With interlaced signals, the odd-numbered and even-numbered lines are transmitted in succession every 1/60th of a second. A8133-A8134 (Myler). The television displays the sets of lines to create the overall picture, and this occurs so quickly that it is imperceptible to the human eye. A8134 (Myler).



Digital television screens have individual pixels defining a fixed number of horizontal lines (usually 1080 or 720), and they display a progressive signal. A8134-A8136 (Myler). If the broadcast video signal does not have the same

number of lines as the screen, or if the signal is interlaced, then the signal must be processed to display correctly. A8135-A8142 (Myler).

Digital televisions therefore include two types of circuits—a scaler and a deinterlacer—that process the video signals to match the format of the display. A8175 (Myler). Scalers expand or reduce the number of lines in a video image frame (and number of pixels in each line, accordingly). A8138 (Myler); A8866-A8867 (Reader). Deinterlacers change a video signal from interlaced format to progressive format by adding the missing lines needed to change each field into a full frame. A8135-A8136, A8177-A8178 (Myler).

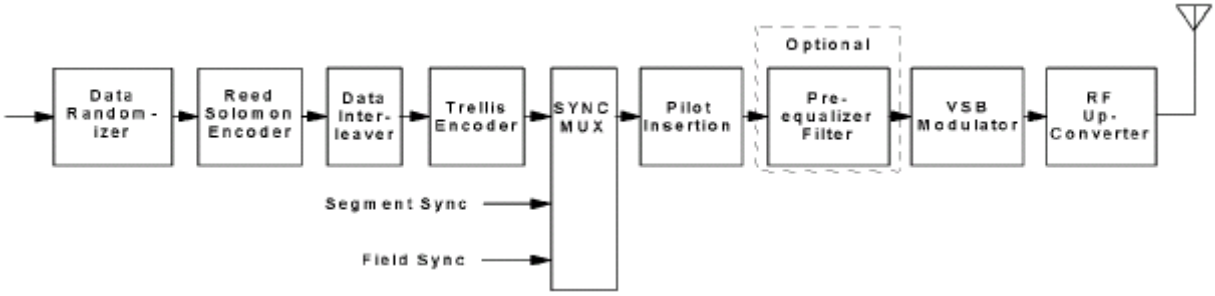
Another significant advantage of digital broadcasting is error correction. With analog broadcasting, interference affected picture quality. A8252-A8254 (Hamilton); A8899-A8900 (Wechselberger). With digital transmission, by contrast, a series of bits (0s and 1s) are transmitted, instructing the television receiver how to display the picture. A8252-A8253 (Hamilton). This allows broadcasters to transmit additional information in the digital signal, providing redundancy. The television receiver can use that information to correct errors caused by transmission interference. A8253-A8257 (Hamilton); A8900-A8901 (Wechselberger). A digital picture is therefore displayed as clearly as it was sent. A8253, A8257 (Hamilton); A8900 (Wechselberger).

Under the ATSC standard, two types of error-correction encoding are performed on the digital signal: Reed-Solomon encoding and trellis encoding. A8900 (Wechselberger). Reed-Solomon encoding involves appending 20 "parity bytes" to the end of every packet of data. A8294 (Hamilton); A8911-A8913 (Wechselberger); A11102-A11103. Reed-Solomon encoding is performed separately on the audio and video portions of the digital signal. A8292-A8294 (Hamilton). Trellis encoding involves taking every two bits and, based on various calculations, adding a third bit. A8256-A8257, A8275-A8278, A8374-A8379 (Hamilton); A8905-A8911 (Wechselberger); A11104-A11108. Trellis encoding is performed on the combined video and audio signal. A8275-A8278 (Hamilton); A11097-A11098, A11104-A11108.

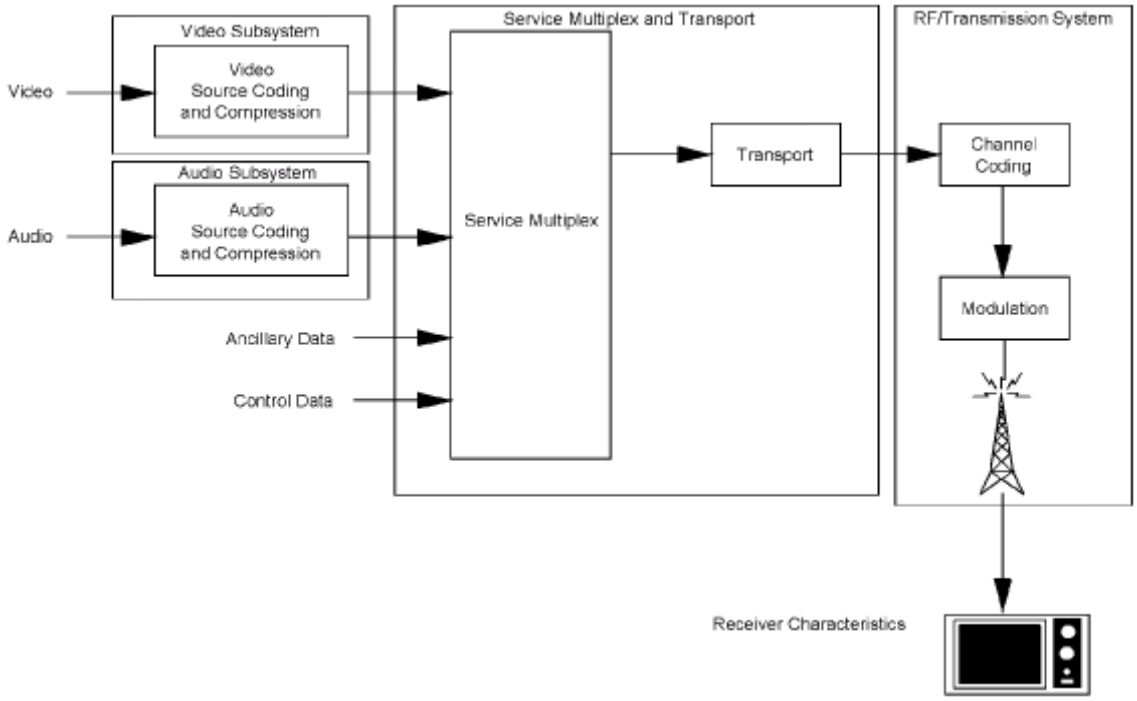
The ATSC standard mandates a particular sequence of steps for transmission. The video and audio signals are each compressed to reduce the amount of data used to represent the signals. A8258-A8259, A8274-A8275 (Hamilton); A8897-A8898 (Wechselberger). The video signal is compressed according to the "MPEG-2" standard developed by the Moving Picture Experts Group, and the audio signal is compressed according to the "AC-3" standard developed by Dolby Digital. A8274-A8275, A8291-A8292, A8306-A8307 (Hamilton); A11073, A11083-A11085. Reed-Solomon and trellis encoding are added to the signal. A8256-A8257, A8275-A8278, A8292-A8295 (Hamilton);

A8900-A8903 (Wechselberger); A11097-A11098; A13859-A13968 at 13880-13900. The digital signal is modulated, i.e., converted into a format that can be transmitted over the airwaves. A8278-A8279 (Hamilton); A8903 (Wechselberger); A11129-A11130; A13934.

These figures from the ATSC standard depict the signal-transmission process:

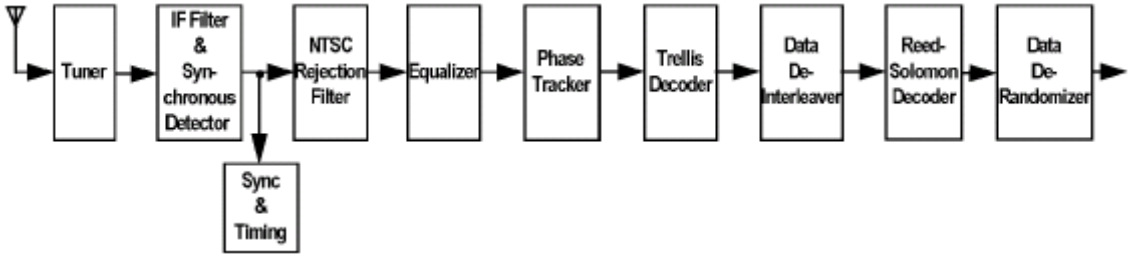


A11098.



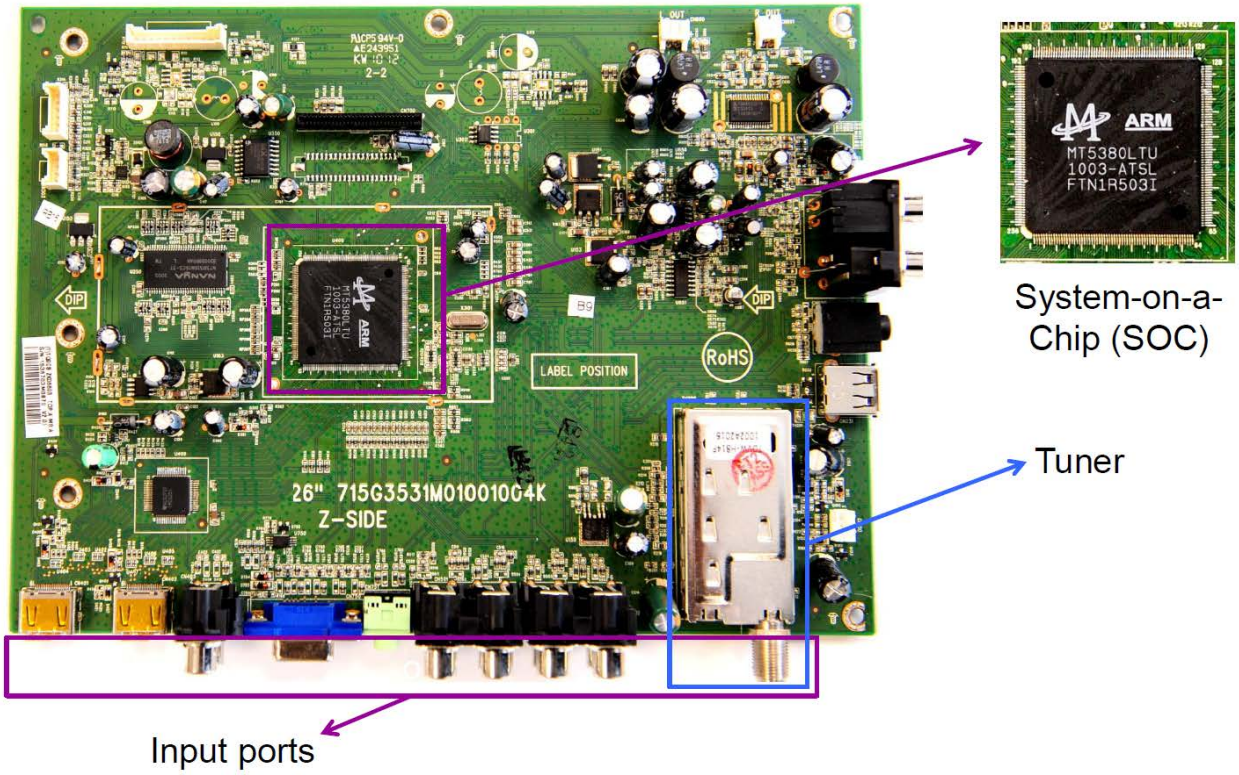
A11097.

Digital television receivers have components that process the received signal in reverse order of the processing that occurred before transmission, thereby restoring the original audio and video. A8903-A8904, A8913-A8914 (Wechselberger); A13943-A13961. The general process is depicted in this figure:



A13943. Television receivers have a tuner that receives the digital signal. A8266, A8271 (Hamilton); A13944-13946. The demodulator converts the received signal into usable form. A8278-A8280 (Hamilton); A8904-A8905 (Wechselberger). Trellis and Reed-Solomon decoders correct any errors in the transmission. A8280-A8283, A8295-A8297 (Hamilton); A8904-A8913 (Wechselberger); A13957-A13960. And expanders decompress the video and audio signals according to the MPEG-2 and AC-3 standards. A8283-A8290 (Hamilton).

In modern televisions, the demodulator, error correctors, and expanders all reside on a single computer chip, known as a "system on a chip" ("SOC"). A8265-A8268 (Hamilton). A typical board containing the tuner and SOC is depicted below:



(discussed at A8265-A8266 (Hamilton)).

3. The ’375 and ’310 patents

The ’375 and ’310 patents claim digital television receivers that are essential to displaying broadcast digital television signals. Hitachi asserted at trial claims 26 and 30 of the ’375 patent (which depend from independent claims 25 and 29, respectively) and claim 7 of the ’310 patent (which depends from independent claim 6). Each asserted claim has five elements: a receiver, a demodulator, an error corrector, a video expander, and an audio expander. A218(col.23:17-47, col.24:18-48); A185-A186(col.18:63-col.20:8).

Claim 25 of the ’375 patent recites: “A digital information receiving apparatus, comprising:” (1) “a receiver configured to receive digital information

. . . , wherein the digital information includes video information . . . , audio information . . . , and error correction information added to the video information and separately added to the audio information"; (2) "a demodulator configured to demodulate the digital information received by the receiver"; (3) "an error corrector configured to correct an error of the digital information demodulated by the demodulator"; (4) "a first expander configured to bit-expand the video information of the digital information error corrected by the error corrector"; and (5) "a second expander configured to bit-expand the audio information of the digital information error corrected by the error corrector." A218(col.23:17-44). Claim 26 recites that "the first compression method utilizes a discrete cosine transform." A218(col.23:45-47).

In claim 30, the error corrector is "configured to correct an error of a digital information which is previously demodulated by the demodulator." A218(col.24:30-32). And the expanders are "configured to bit-expand the [video/audio] information of *a* digital information which is previously error corrected." A218(col.24:36-43) (emphasis added).

Claim 7 of the '310 patent has two main differences from claim 26 of the '375 patent. First, claim 7 uses "digital signal," "video signal," "audio signal," and "error correction signal" rather than "digital information," "video information," "audio information," and "error correction information." A185-A186(col.18:63-

col.20:8). Second, the error correction signal is "added commonly to both the video signal and the audio signal" rather than added separately. A186(col.19:3-5).

4. The '243 patent

The '243 patent claims digital television receivers for receiving and processing a video signal broadcast via a multiplexed signal. Hitachi asserted claims 4 and 5. Claim 5 depends from claim 4, which depends from claim 1. A259(col.7:24-45, col.7:57-67). The claimed receivers have four elements: an isolator, a decoder, a plurality of video processor sections, and a controller. A259(col.7:31-45).

Claim 1 recites: "A digital broadcast receiver unit for receiving a digital multiplexed signal stream . . . , said unit comprising:" (1) "an isolator to isolate one video signal from a received said digital multiplexed signal," (2) "a decoder to decode the video signal," (3) "a plurality of video processor sections, with respective video processor sections providing video processing according to a different video signal format of said plurality of different video signal formats," and (4) "a controller . . . determin[ing] a video signal format of said video signal from said decoder, and selecting one video processor section of said video processor sections to perform video processing." A259(col.7:24-45).

Claim 4 recites that the "plurality of video processor sections is more specifically provided via at least one of a common application specific integrated

circuit (ASIC) and a common microprocessor adapted to selectively perform processing according to any of said plurality of video processor sections." A259(col.7:57-62). Claim 5 recites that "selecting by said controller is more specifically performed by said controller selectively performing processing with respect to said one video processor section while not performing processing with respect to other ones of said video processor sections." A259(col.7:63-67).

5. The '497 patent

The '497 patent claims receivers that can process a signal according to control information specifying a broadcast system standard. Hitachi asserted claims 15 and 16, which claim a television receiver comprising "means for receiving a broadcast program picture and control information . . . , said control information specifying a broadcast system standard," and "means for controlling and displaying said broadcast program picture in accordance with said broadcast system standard by said control information." A243(col.15:44-52, col.16:6-34).

6. The accused devices

The products accused of infringing the '375, '310, and '497 patents are 242 digital television models manufactured by TPV and sold in the United States. A8264 (Hamilton); A8410 (Adam Goldberg, Hitachi's expert on '497 patent); A17425-A17430. The products accused of infringing the '243 patent are 205 digital television models manufactured by TPV and sold in the United States.

A8149 (Myler); A17437-A17442. All accused televisions comply with the ATSC standard. A9008 (Wechselberger).

B. Proceedings Below

1. Claim construction

The district court construed "processing" in the '243 patent to have its plain and ordinary meaning. A44. Pursuant to the parties' agreement, the court also gave "video processor sections" its plain and ordinary meaning. A45. The court construed "video signal format" as "number of scan lines and whether the lines are progressive or interlaced." A49.

2. The DigiCipher document

The case proceeded to trial on Hitachi's claims of infringement of the '375, '310, '243, and '497 patents, as well as TPV's counterclaim that the asserted '375 and '310 patent claims are invalid as anticipated and obvious.[1]

TPV's invalidity case depended on a single document referred to as the DigiCipher document. A8953-A8954 (Wechselberger); A7411-A7412. The DigiCipher document was prepared by General Instrument Corporation, and it describes a digital television architecture prepared by that company. A16841-A16880. TPV contended that the DigiCipher document anticipated claim 7 of the

[1] Before trial, the district court severed Hitachi's infringement claims with respect to five additional patents into a new case, which it dismissed without prejudice. A7740-A7742.

'310 patent and that claims 26 and 30 of the '375 patent are obvious in light of DigiCipher in combination with U.S. Patent No. 5,070,503. A8958-A8967 (Wechselberger).

Before trial, Hitachi moved in limine to preclude introduction of the DigiCipher document because it is not prior art. A4217-A4220; A7119-A7123. It is undisputed that the '310 and '375 patents are entitled to a priority date of July 20, 1990. A9173. Although the DigiCipher document was published by the Institute of Electrical and Electronic Engineers ("IEEE"), that was not until December 1990, some six months *after* the priority date. A9109-A9111 (Hamilton); A15283-A15292. And although the DigiCipher document itself bears a date of "8 June 1990" (A16841), Hitachi's motion in limine contended there was no evidence that the document was publicly accessible in the handful of weeks between that date and the priority date. A4217-A4220; A7119-A7123.

TPV responded that it would proffer testimony, including from former General Instrument employee Scott Lery, to establish when the DigiCipher document became publicly accessible. A7401-A7417 at A7411. The district court denied Hitachi's motion. A7416-A7417.

At trial, even though the DigiCipher document should have been relevant at most to TPV's invalidity case, TPV displayed it to the jury and sought to ask questions about it during Hitachi's infringement case. A8334-A8335, A8342-

A8357. Given the potential prejudice, Hitachi filed an emergency motion requesting a hearing outside the jury's presence to determine whether TPV actually could establish the DigiCipher document's prior-art status. A7776-A7781 at A7779-A7780. The motion was denied. A8534-A8538.

TPV ultimately failed to produce evidence establishing that the DigiCipher document was publicly accessible before the priority date. When TPV examined Lery, all he could say was: "I don't know when this document was given to the public, so to speak. . . . I don't really know exactly when people knew about" the document. A8822. Lery testified only that certain individuals *working for General Instrument* had access to the document, A8816-A8820, and that the document had been submitted at some point to a government agency, but that he did not know when that occurred or whether it was publicly accessible as a result. A8822.

TPV also had promised that testimony from Jeffrey Hamilton, one of Hitachi's infringement experts who happened to have worked at General Instrument, would establish the public accessibility of the DigiCipher document (A7411), but Hamilton's testimony did just the opposite. Hamilton testified that the VideoCipher division within General Instrument "had very well-established document control and secrecy policies" under which the internal DigiCipher document would not have been made public. A9107-A9108. Hamilton further

testified that the editorial policy of the IEEE (which published the DigiCipher information after the priority date) would have precluded publication if the information previously had been published. A9111.

Nevertheless, having gotten the DigiCipher document before the jury, TPV contended that it "went directly to issues of non-infringement and invalidity of the Patents-in-suit." A9548. Although whether Hitachi participated in creation of the ATSC standard has nothing to do with whether TPV infringes, TPV used the American-created DigiCipher document to bolster its central theme to the jury: that Hitachi's patents could not be infringed because Hitachi was not one of the American companies (known as the "Grand Alliance") that developed the standard. *E.g.*, A8389. From the beginning of the trial, TPV's counsel argued that "Hitachi wants to claim credit for the work that the Grand Alliance and those seven U.S. companies did in creating the ATSC standard." A7924. His opening statement continued: "They cannot come in here and take credit for the work that was done. What is it that those engineers half a world away in Japan were actually inventing, if anything?" A7924. He asserted, therefore, that "it's simply not the case" that Hitachi's "patents are necessary or essential to -- to using the ATSC standard for modern televisions in the United States." A7924. Indeed, after trial, TPV's counsel told a legal reporter that TPV's strategy was to convince the jury that Hitachi "didn't contribute anything to the [ATSC] standard." A9699.

3. Infringement of the ’375 and ’310 patents

With respect to the ’375 and ’310 patents, it was undisputed that each accused television receiver has a tuner, a demodulator, a Reed-Solomon decoder, a trellis decoder, a video expander, and an audio expander. A8271-A8300, A8305-A8314 (Hamilton); A9003-A9008 (Wechselberger). It also was undisputed that the receivers process signals with the video signal compressed according to the MPEG-2 standard (using a discrete cosine transform) and the audio signal compressed according to the AC-3 standard. A8274-A8275, A8287-A8289, A8300, A8306-A8307, A8312-A8314 (Hamilton). Moreover, it was undisputed that Reed-Solomon encoding is performed separately on the video and audio signals, that trellis encoding is performed on them commonly, and that both Reed-Solomon and trellis encoding are forms of error correction. A8275-A8278, A8292-A8295 (Hamilton); A8900-A8913, A9006-A9007 (Wechselberger).

TPV’s infringement expert, Anthony Wechselberger, offered two non-infringement theories. First, he asserted that TPV’s televisions do not infringe any of the asserted claims because the ATSC standard requires (and the accused products perform) additional signal processing beyond the processing disclosed in the claims. A8924-A8931. He so opined notwithstanding that the asserted claims are open-ended “comprising” claims, which are infringed regardless of the presence of additional, unrequired elements or steps. A218(col.23:17, col.24:18);

A185(col.18:65). Second, Wechselberger opined that the accused products do not infringe claim 7 of the '310 patent because a trellis encoder does not add a particular type of error correction: a parity signal. A8924. Although Wechselberger testified that claim 7 "says parity is added" (A8924), claim 7 simply recites: "an error correction signal added commonly to both the video signal and the audio signal." A186(col.19:3-5).

4. Infringement of the '243 patent

With respect to claims 4 and 5 of the '243 patent, it was undisputed that the accused television receivers all have the claimed isolater, decoder, and controller. A8151-A8157, A8169-A8174, A8185-A8197 (Myler). It also was undisputed that each device has a scaler and deinterlacer. A8175 (Myler); A8855-A8858 (Reader).

Hitachi's infringement expert, Harley Myler, testified that the scaler and deinterlacer constitute a "plurality of video processor sections." A8174-A8183. Claim 1 (from which claims 4 and 5 depend) recites a plurality of video processor sections "providing video processing according to a different video signal format." A259(col.7:36-37). Myler testified that a scaler provides such processing because it adjusts the picture size to match the television's display size, according to the video signal format of the signal (e.g., 720p). A8181. And a deinterlacer processes according to whether the video signal format is interlaced or progressive. A8177-A8178.

TPV's infringement expert, Clifford Reader, disagreed. A8855-A8858. His non-infringement opinion was based on his view that each video processor section must process the signal according to *both* "the number of lines and whether the lines are interlaced or progressive." A8844.

5. Deliberations, verdict, and post-judgment rulings

During deliberations, the jury asked only one question: it requested a copy of the DigiCipher document. A9267. The jury found the asserted claims of the '310, '375, '243, and '497 patents not infringed, and found claims 26 and 30 of the '375 patent and claim 7 of the '310 patent invalid. A7845-A7849.

The district court denied Hitachi's motions for judgment as a matter of law and for a new trial. A132-A154. As to invalidity, the court concluded a jury could find the DigiCipher document was publicly accessible before the priority date. A146-A148. But the evidence to which the court pointed was testimony that the document was available "within GI" and to a consultant who worked within General Instrument. A146-A147. The district court also relied on testimony that the DigiCipher document had been submitted to the Federal Communications Commission ("FCC") (A147), despite the lack of evidence as to when that occurred or whether the public could access the document as a result.

As to infringement, although the parties' experts agreed how the accused products operate, the district court concluded a jury could have found non-

infringement of the ’375 and ’310 patents. A137. The court reasoned that the jury simply could have disbelieved the uncontroverted testimony of Hitachi’s expert or found the products he examined not representative (although there was no evidence of that). A137. And although TPV’s expert based his non-infringement opinion on additional features of the accused products not required by the claims, the court refused to set aside the verdict. A139. Similarly, with respect to the ’243 patent, although TPV’s expert relied on limitations not required by the claims, the district court upheld the verdict. A153-A154.

Finally, the district court denied Hitachi’s motion contending that the improper introduction of the DigiCipher document required a new trial on all issues. The court premised that denial on the fact that it “found the DigiCipher reference to be prior art and properly admitted in this case.” A145.

SUMMARY OF ARGUMENT

I. TPV’s invalidity case as to the ’375 and ’310 patents hinged on the DigiCipher document being prior art. TPV thus had to prove by clear and convincing evidence that the DigiCipher document was known by others or that it was a printed publication before the July 20, 1990 priority date. The touchstone under both prongs is public accessibility.

TPV did not meet that burden. TPV repeatedly assured the district court that Lery, a former General Instrument employee, would establish public accessibility.

But when he took the stand, Lery acknowledged he did not know when the document became publicly accessible and could only "speculate." A8822. Lery testified that employees and a consultant working *within* General Instrument had access to the document, but such internal individuals are not members of the *public*. Lery also testified that a "government agency had a copy of it" (A8822), but he did not testify *when* the government agency received it. Moreover, mere submission to a government agency does not show public accessibility unless the general public would know about the document and be able to access it. No evidence of that exists here. Nor did the testimony of Hitachi's infringement expert, Hamilton (a former General Instrument employee), show public accessibility, as TPV had promised. Indeed, Hamilton's testimony showed the opposite. The denial of Hitachi's motion for judgment as a matter of law should be reversed, and judgment of non-invalidity should be ordered.

II. With respect to infringement of the '375 and '310 patents, it was undisputed that the accused televisions possess the claimed receiver, demodulator, error corrector, and video and audio expanders. TPV's expert testified that each is present in the accused televisions. TPV's non-infringement theory was that the accused devices nevertheless do not infringe because they contain additional elements not required by the claims. But the asserted claims are open-ended

"comprising" claims; the presence of additional elements cannot avoid infringement.

TPV also asserted that claim 7 of the '310 patent is not infringed because the accused error-correction signal is not a "parity" signal. TPV's expert testified: "[t]he claim[] says parity is added. The name of the game is the claims. That doesn't happen here." A8924. But claim 7 says nothing about a parity signal. It requires only an "error correction signal added commonly to both the video signal and the audio signal." A186(col.19:3-5). There was no dispute that trellis encoding is error correction encoding performed on the video and audio signals commonly. No reasonable jury could have found non-infringement.

III. As for infringement of the '243 patent, it was undisputed that all the accused televisions have the claimed isolater, decoder, and controller. It also was undisputed that the televisions possess scalers and deinterlacers that provide video processing and that accept different video signal formats.

TPV's expert opined that the accused products do not infringe because they purportedly lack the claimed plurality of video processor sections. He so opined because the products do not possess a video processor section that provides processing according to *both* number of lines and whether a signal is interlaced or progressive—i.e., the scaler and deinterlacer do not each operate based on both of these characteristics.

But processing based on two distinct characteristics is found nowhere in the claims. The claims require only "video processing according to a different video signal format," which the accused products do provide. Judgment of infringement as a matter of law should have been granted.

IV. At the very least, a new trial is warranted on infringement because of the erroneous admission of the DigiCipher document. TPV used the DigiCipher document not only for invalidity but also to argue non-infringement. The DigiCipher document never should have come in because it was not prior art. Because there is a substantial risk that Hitachi was prejudiced by the document's erroneous admission, a new trial is required if judgment of infringement is not ordered.

STANDARD OF REVIEW

The denial of judgment as a matter of law is reviewed under regional circuit law. *ClearValue, Inc. v. Pearl River Polymers, Inc.*, 668 F.3d 1340, 1343 (Fed. Cir. 2012). The Fifth Circuit reviews denials de novo. *Id.* (citing *Medical Care Am., Inc. v. National Union Fire Ins. Co.*, 341 F.3d 415, 420 (5th Cir. 2003)). "[T]he jury's determination must be supported by substantial evidence." *Id.* Judgment as a matter of law is required where "a reasonable jury would not have a legally sufficient evidentiary basis" for the verdict. Fed. R. Civ. P. 50(a)(1).

Whether a document qualifies as prior art under 35 U.S.C. § 102(a) is a legal determination, based on underlying facts. *In re Lister*, 583 F.3d 1307, 1311 (Fed. Cir. 2009).

The denial of a new trial is reviewed under regional circuit law. *SynQor, Inc. v. Artesyn Techs., Inc.*, 709 F.3d 1365, 1383 (Fed. Cir. 2013). The Fifth Circuit reviews such denials for "'abuse of discretion or a misapprehension of the law.'" *Id.* (quoting *Prytania Park Hotel, Ltd. v. General Star Indem. Co.*, 179 F.3d 169, 173 (5th Cir. 1999)). A new trial is warranted where there is a reasonable likelihood that prejudicial error affected a party's substantial rights, *Johnson v. William C. Ellis & Sons Iron Works, Inc.*, 609 F.2d 820, 823 (5th Cir. 1980), or the verdict is against the great weight of the evidence, *Poly-America, L.P. v. GSE Lining Tech., Inc.*, 383 F.3d 1303, 1312 (Fed. Cir. 2004).

ARGUMENT

I. THE INVALIDITY JUDGMENT ON THE '375 AND '310 PATENT CLAIMS MUST BE REVERSED BECAUSE IT HINGES ON A SINGLE REFERENCE THAT IS NOT PRIOR ART

There was no evidence—much less clear and convincing evidence—that the DigiCipher document was available to the general public before the priority date of the '375 and '310 patents. Judgment of non-invalidity as a matter of law should be ordered.

A. TPV Had To Prove By Clear And Convincing Evidence That The DigiCipher Document Was Publicly Accessible In The Several Weeks Between Its Date And The Priority Date

To prevail on its invalidity defense, TPV had to prove by clear and convincing evidence that "the invention was known . . . by others in this country . . . or described in a printed publication in this or a foreign country, *before* the invention thereof by the applicant for patent." 35 U.S.C. § 102(a) (emphasis added). To prove that the invention was "known," TPV had to establish that the knowledge was "available to the public." *Woodland Trust v. Flowertree Nursery, Inc.*, 148 F.3d 1368, 1370 (Fed. Cir. 1998); *see Carella v. Starlight Archery & Pro Line Co.*, 804 F.2d 135, 139 (Fed. Cir. 1986). Likewise, for a document to be a "printed publication," it "must be generally available" to the public. *Northern Telecom, Inc. v. Datapoint Corp.*, 908 F.2d 931, 936 (Fed. Cir. 1990). Indeed, public accessibility is "the touchstone in determining whether a reference constitutes a 'printed publication.'" *Lister*, 583 F.3d at 1311 (quoting *In re Hall*, 781 F.2d 897, 898-899 (Fed. Cir. 1986)). Thus, the key under both prongs of Section 102(a) is public accessibility. "A reference is considered publicly accessible if it was 'disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, can locate it.'" *Id.* (quoting *Kyocera Wireless Corp. v. International Trade Comm'n*, 545 F.3d 1340, 1350 (Fed. Cir. 2008)).

On the facts here, meeting that heavy burden required threading a very small needle. TPV's entire invalidity challenge depended on a single alleged prior art reference, an internal General Instrument document. That DigiCipher document bore a date just weeks before the undisputed July 20, 1990 priority date: "8 June 1990." A16841. At most, that June 8 date establishes that the document was created as of then, not that the general public could access it. *ResQNet.com, Inc. v. Lansa, Inc.*, 533 F. Supp. 2d 397, 414 (S.D.N.Y. 2008), *aff'd in relevant part*, 594 F.3d 860, 865 (Fed. Cir. 2010) (per curiam). Moreover, the DigiCipher document was not published until several months *after* the priority date, in a December 1990 IEEE journal. That journal had a policy of not publishing any paper that had been "submitted or published elsewhere." A9110-A9111; A15283-A15292. Thus, nothing about the documentary evidence established that the DigiCipher document was publicly accessible before the critical date.

Instead, TPV tried to use witness testimony to prove the DigiCipher document was prior art. The bar for doing so is high: "Although in some circumstances unsupported oral testimony can be sufficient to prove prior knowledge or use, it must be regarded with suspicion and subjected to close scrutiny." *Carella*, 804 F.2d at 138. As discussed below, none of the testimony introduced by TPV came close to proving (much less by clear and convincing

evidence) that the DigiCipher document became publicly accessible during the few short weeks between its date and the priority date.

B. The Trial Testimony Did Not Establish By Clear And Convincing Evidence The Public Accessibility Of The DigiCipher Document Before The Priority Date

In response to Hitachi's motion for judgment as a matter of law, TPV pointed only to the following testimony to try to support the verdict: (1) former General Instrument employee Lery was given the DigiCipher document when he joined General Instrument; (2) Lery's office mate at General Instrument, who was a consultant, had the document; (3) the document was available to employees of General Instrument; (4) the document was submitted to a government agency at some unspecified time; (5) the document was not marked confidential; and (6) there was a single press release of unspecified content about the system. A9656-A9661. At most, the evidence showed that the document was accessible *within* General Instrument before the priority date and that it became publicly accessible only at some unknown date. That is not enough to invalidate these patents.

1. Lery's testimony did not establish public accessibility of the DigiCipher document before the priority date

TPV relied primarily on Lery's testimony, the entirety of which is reprinted in the joint appendix. A8814-A8824. Lery testified that he started at General Instrument "in late June of 1990" and that he "was asked to design and help build

an HDTV system for over-the-air broadcast television." A8815. Lery testified his supervisor gave him the DigiCipher document within a day or two after his arrival. A8815-A8816.

But on the key question concerning the public accessibility of the DigiCipher document, Lery testified that he did not know and could only speculate. Lery's testimony on that point is as follows:

> Q. Mr. Lery, . . . is it true that you just don't know the exact date as to when it became publicly known?
>
> A. Well, would -- I guess I'm not sure about what publicly known means. It was certainly in this document. This document was known by certainly the government agency that this was submitted to -- public agency it was submitted to.
>
> I -- I -- I honestly can say that, you know, it was in this document. *I don't know when this document was given to the public*, so to speak. I mean, I just know that it was readily available to anybody at GI, and the government agency had a copy of it. And as far as the -- the -- a detail like that, the error correction system, I can only, you know, speculate.
>
> *I don't really know exactly when people knew about* -- it would be more -- the question would be about how many people knew about this document.

A8822 (emphasis added).

Lery also testified that his "office mate" at General Instrument, a "consultant" hired by General Instrument to work "very close[ly]" with Lery, had access to the document:

> Chris Heegard was my office mate, and so we worked very close together. And this document was at least discussed quite a bit, and we had this thing out all the time in the office laying around and talked about it a lot.

A8819.

Far from establishing that the information in the DigiCipher document was publicly accessible, Lery's testimony demonstrates the absence of such proof. That the document "was readily available to anybody at GI," including a consultant who worked there, does not prove that the public had access to it. *Northern Telecom*, 908 F.2d at 936-937 (affirming judgment of non-invalidity as a matter of law where alleged prior-art documents were "housed in a library at the Mitre Corporation," were accessible to Mitre staff, "were not under security classification, and were distributed to approximately fifty persons or organizations involved in the . . . project").

Nor is Lery's passing reference to the document being submitted to a government agency sufficient to show whether and when it was publicly accessible. Lery testified only that "the government agency had a copy of it."

A8822. He never testified that the document was submitted to the government agency at the critical time, before the priority date.

Nor did Lery testify that the public could have accessed the document from the government agency. Mere "'distribution to government agencies and personnel alone'" is insufficient without evidence that the government submission also made the document generally available to the public. *Northern Telecom*, 908 F.2d at 936 (quoting *Garrett Corp. v. United States*, 422 F.2d 874, 878 (Ct. Cl. 1970)). Thus, in *Lister*, an alleged prior-art manuscript was submitted to the Copyright Office over one year before the critical date, and it "was available upon request to be inspected by the public." 583 F.3d at 1310, 1313. Yet this Court held the manuscript was not publicly accessible because there was no evidence the public could learn of its existence through a searchable public database before the critical date. *Id.* at 1317; *see de Graffenried v. United States*, 20 Cl. Ct. 458, 470-471 (1990) (concluding that a document included in a database restricted to government agencies, contractors, and grantees was not publicly accessible). So too here.

Lery also testified that the DigiCipher document was not marked "confidential" within General Instrument. His complete testimony on that issue is as follows:

> Q. Did you become aware at any time that the information contained in the document was to be maintained in confidence?
>
> A. No. No, sir.
>
> Q. Now, during your time at General Instrument, did you learn about General Instrument's practice for when they did want to maintain a document in confidence?
>
> A. Yeah. They were -- like most companies, if you had something that was kept -- kept for the company eyes only, so to speak, you were told that, you know, these doc -- the documents on a particular project, they were to be kept, you know, a lot of times just in your office.
>
> But more so, they were also stamped, all the pages were stamped sometimes to where you couldn't even read the print, but, you know, they were stamped General Instrument proprietary or something to that nature.
>
> Q. Does the document you have before you as Defendants' Exhibit 599, is that one stamped General Instrument proprietary or have any other confidential label?
>
> A. Certainly not that I can see and I don't ever remember there being one.

A8817-A8818.

But an absence of confidentiality markings does not mean a reference is publicly accessible. Where the document "is not marked with any indicium of . . . secrecy," it cannot be considered publicly accessible without evidence that the document "was ever published or disseminated to the public." *ResQNet.com, Inc.*

v. Lansa, Inc., 594 F.3d 860, 865 (Fed. Cir. 2010) (per curiam). Even documents intended specifically for public distribution are not publicly accessible prior art without "information about the circulation and availability." *In re Omeprazole Patent Litig.*, 536 F.3d 1361, 1381 (Fed. Cir. 2008).

Finally, Lery testified that there was a single press release about the DigiCipher system:

> Q. During your time at General Instrument, did you ever see any press releases about the DigiCipher system?
>
> A. Yes, I did. I might say that I was given the press release Xeroxed from a newspaper probably about the same time I got this document.

A8818. But there was no evidence that the press release disclosed any of the technical information in the 40-page DigiCipher document. Nor was any press release ever entered into evidence because, *inter alia*, TPV had no sponsoring witness to lay any foundation. A7452-A7455. Testimony concerning the bare existence of a press release "about the DigiCipher system" (A8818) cannot establish that the DigiCipher document was publicly accessible before July 20, 1990.

2. Neither Henderson's nor Reader's testimony established public accessibility of the DigiCipher document before the priority date

The district court relied on testimony offered by two other witnesses, Henderson and Reader, as supporting the jury's verdict. A147. Neither witness, however, gave testimony from which a jury could infer that the information in the DigiCipher document was publicly accessible before the priority date.

Henderson was a former Hitachi employee and consultant involved in "working parties" that were developing standards. A8794-A8799. As part of that work, he listened to presentations by companies, universities, and others proposing systems. A8799-A8800. His working group listened to a presentation about the DigiCipher system, which was the first all-digital system proposed. A8800.

But Henderson did not testify about when that presentation took place. A8800. He further testified:

> QUESTION: Do you recall if you learned about DigiCipher in June of 1990?
>
> ANSWER: I don't recall when I learned about DigiCipher.
>
> You're asking me what I know from -- from what I remember?
>
> QUESTION: Sure.
>
> ANSWER: You know, I don't remember that.

A8802.

Similarly, Reader testified that he was the leader of the United States delegation to the Moving Picture Experts Group. A8830. He stated that "General Instrument made its proposal to the ATSC for an all-digital, high-definition television system." A8831. But Reader did not testify when that presentation occurred. A8829-A8832.

Nor did Henderson or Reader testify that the *information* contained in the DigiCipher document was presented to any working group. They testified only generally that a DigiCipher presentation was made. That does not establish public accessibility of the DigiCipher document. In *Norian*, this Court affirmed judgment of non-invalidity as a matter of law where the alleged prior art was a research abstract for a conference presentation: no witness testified "whether copies of the Abstract were actually available to hand out," even though it was the "general practice" for "presenters to hand out abstracts to interested attendees." *Norian Corp. v. Stryker Corp.*, 363 F.3d 1321, 1330 (Fed. Cir. 2004). Likewise, even if a presentation had been made before the critical date (which neither Henderson nor Reader testified), the mere fact of a presentation of unknown content is not enough to meet TPV's burden.

3. Hamilton's testimony showed that the DigiCipher document was not publicly accessible

Far from establishing the DigiCipher document's prior-art status (as TPV promised pre-trial, A7411), the testimony of Hitachi's expert Hamilton showed it

was not publicly accessible until its publication in December 1990, after the priority date.

Hamilton, who had been employed at General Instrument in June 1990 (A9107), testified that the VideoCipher division within General Instrument "had very well-established document control and secrecy policies" because "they had a history in making products for the U.S. military for encrypting and securing communications." A9107-A9108. That division thus "had very much of a need-to-know philosophy on releasing documents." A9108. Indeed, Hamilton testified that, while working at General Instrument, he needed access to information about the DigiCipher system so he could "build a system using the same technology on cable." A9108. But because he worked in a different division, his division had "quite a difficult time getting [the VideoCipher division] to share that -- the specifications with us." A9108. Based on his experiences, he testified that a member of the general public could not have obtained a copy of the DigiCipher document from General Instrument. A9108.

Concerning Lery's office mate at General Instrument, Hamilton explained that it was "standard practice at General Instrument" for such consultants to sign a non-disclosure agreement "promising the work he was doing for us would be kept secret." A9109.

Hamilton also explained that the post-priority-date publication of the DigiCipher document in an IEEE technical journal indicated that it had not been published before. A9110-A9111; A15283-A15292. IEEE's editorial policy precluded publication of any paper that already had been "submitted or published elsewhere." A9111. Indeed, Hamilton testified that he recalled the IEEE December 1990 publication because "[i]t was informative to [him]," even though he was at General Instrument. A9111.

Hamilton's uncontroverted testimony could support only a finding that the DigiCipher document was not publicly accessible before the priority date.

* * *

This Court has not hesitated to sustain judgment as a matter of law when the evidence of public availability is insufficient to support a jury's invalidity verdict. *See, e.g.*, *Norian*, 363 F.3d at 1330. Judgment of non-invalidity as a matter of law is warranted here. In the alternative, because the jury's verdict is against the great weight of the evidence, the Court at least should remand for a new trial on validity. *See Poly-America*, 383 F.3d at 1312.

II. JUDGMENT OF INFRINGEMENT AS A MATTER OF LAW SHOULD HAVE BEEN GRANTED ON THE '375 AND '310 PATENT CLAIMS BECAUSE UNCLAIMED FEATURES CANNOT DEFEAT INFRINGEMENT

Once the judgment of invalidity is set aside, the evidence supports only a finding that the asserted '375 and '310 patent claims are infringed. Hitachi's and

TPV's experts agreed on the operation of the accused products. Their testimony established that TPV's devices contain each of the elements required by the claims. TPV offered two non-infringement theories, but each related to features not found in the claims. But as the district court correctly instructed the jury, all the asserted claims in these two patents are "comprising" claims. A185(col.18:65); A218(col.23:17, col.24:18); A9184. TPV's expert's testimony about additional features thus could not legally support non-infringement. *Moba, B.V. v. Diamond Automation, Inc.*, 325 F.3d 1306, 1313-1314 (Fed. Cir. 2003) (per curiam) (reversing denial of judgment of infringement as a matter of law where testimony concerning non-infringement was based on limitations not in the claims); *Integra Lifesciences I, Ltd. v. Merck KGaA*, 496 F.3d 1334, 1341-1342 (Fed. Cir. 2007) (expert testimony based on erroneous view of law cannot sustain jury verdict). Once that testimony is set aside, the undisputed evidence warrants judgment of infringement as a matter of law. *Boston Scientific Scimed, Inc. v. Cordis Corp.*, 554 F.3d 982, 992 (Fed. Cir. 2009) (noting the standards for judgment as a matter of law and summary judgment are the same). That is particularly so where, as here, the accused infringer's expert admits facts that amount to infringement. *Broadcom Corp. v. Emulex Corp.*, 732 F.3d 1325, 1333 (Fed. Cir. 2013).

A. Uncontroverted Evidence Established The Accused Products Possess Each Of The Elements Of The Asserted ’375 And ’310 Patent Claims

Undisputed evidence established that all of the accused devices contain each limitation of the asserted claims.

Each asserted claim of the ’375 and ’310 patents requires a receiver, a demodulator, an error corrector, a video expander, and an audio expander. A218(col.23:17-47, col.24:18-48); A185-A186(col.18:63-col.20:8). Hitachi’s expert Hamilton explained in detail how the accused devices infringe. A8261-A8300, A8305-A8314. All of the accused televisions comply with the ATSC standard, as required by federal law. A8262-A8264 (Hamilton). In particular, each of the accused products has a tuner circuit, which receives the transmitted digital signal. A8266, A8271-A8274, A8290-A8291, A8305-A8306 (Hamilton); A13943-A13946; A14786-A14873 at A14796-A14797 (Figure 4.2 including a tuner); A11991 (tuner in depicted system). As required by the ATSC standard, the received digital signal includes a video signal that has been compressed according to the MPEG-2 video standard, as well as an audio signal that has been compressed according to the AC-3 audio compression standard. A8274-A8275, A8291-A8292, A8306-A8307 (Hamilton); A11073, A11083-A11085.

The transmitted digital signal is processed to include two types of error-correction information—Reed-Solomon and trellis encoding—which allow the

receiver to recover any lost or corrupted data. A8256-A8257, A8275-A8278, A8292-A8295, A8306-A8307 (Hamilton). As required by claims 26 and 30 of the '375 patent (A218(col.23:24-26, col.24:25-27)), Reed-Solomon error-correction encoding is added separately to the audio and video information. A8292-A8295, A8306-A8307, A8380-A8381 (Hamilton); A8911-A8912 (Wechselberger); A11097-A11098, A11101-A11103. As required by claim 7 of the '310 patent (A186(col.19:3-5)), trellis encoding is performed commonly on both the video signal and the audio signal. A8256-A8257, A8275-A8278 (Hamilton); A11097-A11098, A11104-A11108.

The accused products also all have demodulators, error correctors (trellis and Reed-Solomon decoders), and video and audio bit-expanders, all residing on a single computer chip. A8265-A8268, A8278-A8290, A8295-A8300, A8306-A8314 (Hamilton); A12149-A12150; A13103; A14416-A14417. The demodulators demodulate the received digital signal. A8255, A8278-A8280, A8295, A8307-A8309 (Hamilton); A8904 (Wechselberger); A11141; A14162; A15175. The Reed-Solomon and trellis decoders correct errors in the digital information. A8280-A8283, A8295-A8297, A8309-A8311 (Hamilton); A13943-A13944, A13957-A13960. And the bit-expanders expand the video and audio information according to the MPEG-2 and AC-3 standards, respectively. A8283-

A8287, A8298-A8299, A8311-A8314 (Hamilton); A13880-A13881, A13893-A13894; A14190.

Moreover, Hamilton explained in detail that the specific limitation added by each dependent claim is present in the accused products. In particular, he explained that the video compression method used is "discrete cosine transform," as required specifically by claims 26 and 30 of the '375 patent and claim 7 of the '310 patent. A218(col.23:45-47, col.24:46-48); A186(col.20:7-8); A8287-A8290, A8300, A8313-A8314 (Hamilton).

TPV's expert, Wechselberger, did not dispute that these components are all present in the accused devices. He acknowledged the accused products all comply with the ATSC standard. A9008. Indeed, he testified that the FCC mandates that transmitted signals be ATSC compliant, and thus "by virtue of building an ATSC-compliant receiver, you have to do these [ATSC-required] processes in the television, or you get no picture." A8904. Wechselberger testified that he "looked at the SOC chips that are the main component in the televisions themselves and confirmed that they perform these functions" required by the ATSC. A8904. He specifically agreed that each accused device includes a tuner, a demodulator, a Reed-Solomon decoder, a trellis decoder, an MPEG-2 video expander, and an AC-3 audio expander. A9003-A9008.

Despite the experts' complete agreement concerning the operation of the accused devices, the district court denied Hitachi's motion for judgment of infringement as a matter of law. The court reasoned that the jury could have found "that Hitachi failed to make a *prima facie* case of infringement" because the jury was "at liberty to disbelieve Mr. Hamilton's infringement testimony, or find the selection of documents was not representative of all the accused products." A137.

That was legal error. Because there was complete agreement between Hitachi's and TPV's experts, there was no basis to conclude that the jury could simply have disbelieved Hitachi's evidence. *Larry Harmon Pictures Corp. v. Williams Rest. Corp.*, 929 F.2d 662, 663 n.1 (Fed. Cir. 1991). Were it otherwise, a court could virtually never grant judgment as a matter of law or summary judgment (for which the legal standards are the same, *see Boston Scientific Scimed*, 554 F.3d at 992), because a jury always might choose to disbelieve all of a party's evidence. Credibility concerns thus are insufficient to defeat such a motion "where there is an absence of probative evidence conflicting with the evidence presented." *Larry Harmon Pictures*, 929 F.2d at 663 n.1; *see Schoonejongen v. Curtiss-Wright Corp.*, 143 F.3d 120, 130 (3d Cir. 1998).

Nor was the jury free to disregard the unrebutted testimony that each of the accused products has the claimed components. Indeed, Wechselberger confirmed that all of the accused products comply with the ATSC standard and contain

tuners, demodulators, Reed-Solomon decoders, trellis decoders, and video and audio expanders. A9003-A9008. Wechselberger's testimony alone was sufficient to support judgment of infringement as a matter of law. *Broadcom*, 732 F.3d at 1333.

B. TPV's Non-Infringement Theory Fails As A Matter Of Law Because The Claims Do Not Preclude Additional Components

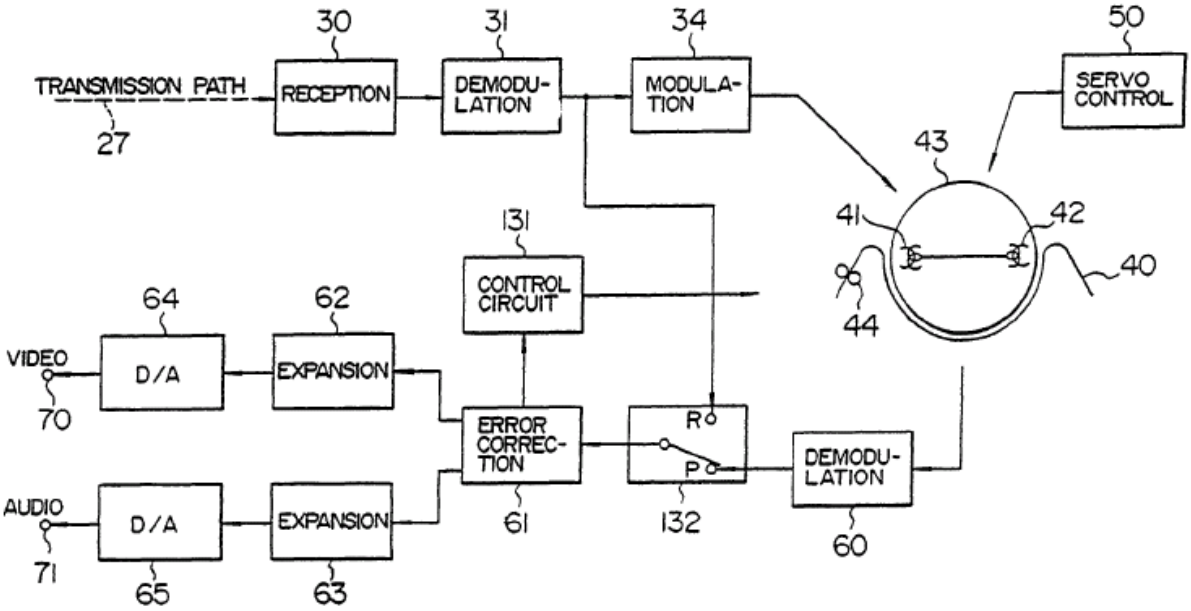
Wechselberger offered a single non-infringement theory as to all asserted claims of the '375 and '310 patents: that the receivers do not infringe because, in addition to the processing components actually claimed by the patent, the accused television receivers also include other components necessary to process an ATSC-compliant television signal. But the presence of such additional components cannot defeat infringement because nothing in the claims precludes additional processing elements beyond those claimed. To the contrary, as the district court correctly instructed the jury, all the asserted claims in these two patents are "comprising" claims. A185(col.18:65); A218(col.23:17, col.24:18); A9184.

1. Wechselberger relied on additional features not in the asserted claims

Wechselberger explained his non-infringement theory to the jury by comparing Figure 4 of the patents' common specification to a figure from the ATSC standard. Addressing the '375 patent claims, Wechselberger testified that Figure 4 shows data flowing directly from the demodulator (box 31) to the error

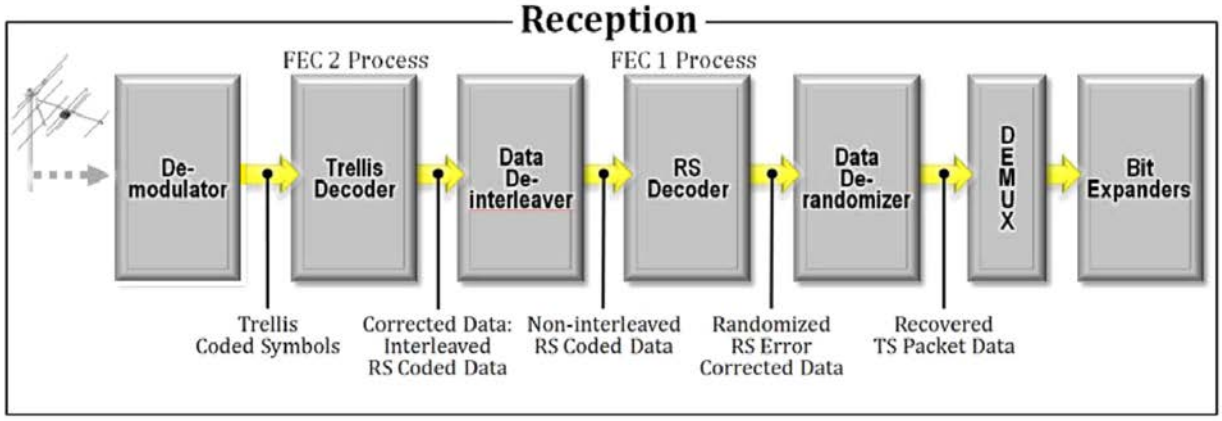
corrector (box 61). A8934. He described this as requiring a "direct path" between the demodulator and the error corrector (when the box 132 switch is moved). A8934.

FIG. 4



A162; A192.

Wechselberger contrasted that supposed "direct path" with a demonstrative he made showing the operation of the accused products (adapted from Figure 9.1 of the ATSC A/54A standard, A13943):



Wechselberger testified that the '375 patent is not infringed because "there are signal processing blocks between the output [of the] demodulator and the input of the Reed-Solomon decoder" (i.e., the accused error corrector). A8934. In particular, there is a trellis decoder and a data deinterleaver. A8934. Wechselberger stated that these additional processors "change[] the signal. So by the time that signal gets to the Reed-Solomon decoder, it is no longer this signal that the claim element requires." A8934.

Similarly, with respect to claim 7 of the '310 patent, Wechselberger posited that the accused products do not infringe because the claim purportedly requires that the output of the error corrector flow directly to the bit-expanders. His non-infringement theory relies on the existence of other components in the accused products between the trellis decoder (the accused error corrector with respect to the '310 patent) and the bit-expanders: "There is a data de-interleaver block. There is a Reed-Solomon decoder block. There is a data -- a data de-randomizer block. And then the de-multiplexer sits between the bit-expander and the trellis decoder."

A8926. He further testified that these components process the signal, even though those components are not in the claims:

> [A]lthough the claim says you must bit-expand the signal that -- the output from the error corrector, which in this case is the accused trellis decoder. That doesn't happen.
>
> There's several signal processing blocks that stand between the output of the trellis decoder and the bit-expander. Every one of these signal blocks process that signal.
>
> They're there for a reason. This signal in the middle is not the same as that one that went in; contrastly this one changes again; this one changes again.
>
> So bottom line is, what's being bit-expanded is not the same signal, and I think I highlighted that.

A8925-A8926.

2. TPV's additional features cannot defeat infringement

Accepting as true Wechselberger's explanation of how the accused devices operate, this non-infringement theory fails as a matter of law. As the district court correctly instructed the jury (A9184), each asserted claim is a "comprising" claim. A218(col.23:17, col.24:18); A185(col.18:65). "It is fundamental that the use of this phrase as a transitional phrase 'does not exclude additional unrecited elements, or steps (in the case of a method claim).'" *Dow Chem. Co. v. Sumitomo Chem. Co.*, 257 F.3d 1364, 1380 (Fed. Cir. 2001) (quoting *Moleculon Research Corp. v. CBS, Inc.*, 793 F.2d 1261, 1271 (Fed. Cir. 1986)). "[A]bsent some special

circumstance or estoppel which excludes the additional factor, infringement is not avoided by the presence of elements or steps in addition to those specifically recited in the claim." *Vivid Techs., Inc. v. American Sci. & Eng'g, Inc.*, 200 F.3d 795, 811 (Fed. Cir. 1999). "Adding features to an accused device will not result in noninfringement if all the limitations in the claims, or equivalents thereof, are present in the accused device." *Uniroyal, Inc. v. Rudkin-Wiley Corp.*, 837 F.2d 1044, 1057 (Fed. Cir. 1988); *see Stiftung v. Renishaw PLC*, 945 F.2d 1173, 1178-1179 (Fed. Cir. 1991) (reversing judgment of non-infringement and holding claims infringed as a matter of law because the claims did not preclude additional elements); *Amstar Corp. v. Envirotech Corp.*, 730 F.2d 1476, 1481-1482 (Fed. Cir. 1984) (same).

The claims here lack anything that would override the fundamental rule that adding additional structure does not avoid infringement. Nothing in the claims indicates that infringement is defeated by the presence of additional components between the demodulator and Reed-Solomon decoder or between the trellis decoder and bit-expanders.

To the contrary, the claims simply recite the order in which the recited elements process the signal. The '375 patent claims require only that the error corrector (i.e., the Reed-Solomon decoder) correct any errors in the received signal at some point after that signal is demodulated. Claim 26 recites that the error

corrector be "configured to correct an error of the digital information demodulated by the demodulator based on the error correction information." A218(col.23:29-31). And claim 30 recites that the error corrector be "configured to correct an error of a digital information which is previously demodulated by the demodulator based on the error correction information." A218(col.24:30-32). Regardless of the presence of any additional elements between the demodulator and the Reed-Solomon decoder, the Reed-Solomon decoder in the accused products corrects errors in the demodulated signal.

Likewise, claim 7 of the '310 patent requires only that the expanders decompress the audio and video signals after error correction is performed. Claim 7 recites that each expander "bit-expands the video [or audio] signal of the digital signal corrected by the error corrector" (i.e., the trellis decoder). A186(col.20:1-5). Regardless of additional elements between the trellis decoder and the expanders, the expanders in the accused products decompress the error-corrected signal.

That the claims simply recite an order is confirmed by the language of claim 30 of the '375 patent. Claim 30 requires only that the error corrector be "configured to correct an error of a digital information *which is previously demodulated* by the demodulator." A218(col.24:30-32) (emphasis added). Wechselberger's demonstrative confirms that Reed-Solomon decoding is

performed on digital information that previously was demodulated. *Supra* pp. 46-47. Indeed, he specifically testified that "demodulation . . . come[s] before error correction" in the accused devices. A9008.

Wechselberger's non-infringement theory is based on the phrase "*the* digital *signal*." His theory is that the claims require that "the . . . signal" output from one component be the exact same signal input into another component, which purportedly precludes any intervening processing. A8925-A8926, A8934. He testified that additional "signal processing" components mean that the "signal that's being bit-expanded is not the same signal that is being error corrected." A8925-A8926; *see* A8934 (each additional processor "changes the signal" so that "it is no longer this signal that the claim element requires"); A8903 ("Each one of these steps changes the signal, does something to it.").

As an initial matter, claims 26 and 30 of the '375 patent do not recite "the digital signal," but rather "*the* digital *information*" and "*a* digital *information*." A218(col.23:29-30, col.24:30-31) (emphasis added). Wechselberger offered no testimony (nor could he) that additional processing components modify the digital "information" (i.e., the content) represented by the digital signal. To the contrary, he testified that "the information . . . flows through a number of steps on its way to being constructed into a picture." A8903. The whole point of the processing is to be able to display the content that was broadcast.

Even as to claim 7 of the ’310 patent, which does recite “the digital signal,” the audio and video expanders still bit-expand the audio and video content of the error-corrected digital signal. There is no dispute that in the accused products, the signal gets trellis decoded (error corrected) before being processed by the audio and video expanders. A9008. Nor is there any dispute that the expanders actually do decompress the trellis-decoded signal containing the audio and video content. A9008. That is all the claims require. Indeed, Wechselberger conceded that “within the signals at each chain, there is ultimately going to be a representation of audio and video.” A9002.

Although the district court correctly instructed the jury that “comprising” claims do not preclude additional elements (A9184), the court’s denial of Hitachi’s motion for judgment as a matter of law effectively allowed the jury to disregard that instruction and add a limitation to the claims. That was error. *Moba*, 325 F.3d at 1313-1314 (reversing denial of judgment of infringement as a matter of law: “In essence, the district court allowed the jury to add an additional limitation to the district court’s construction of ‘guiding steps.’”). Moreover, because Wechselberger’s non-infringement testimony was based on an incorrect view of what the claims require, his testimony cannot support the verdict. *Integra*, 496 F.3d at 1341-1342. Hitachi established that all the required elements are present in

the accused devices, and TPV's non-infringement theory fails as a matter of law. Judgment as a matter of law should have been granted for Hitachi.

C. The Fact That Trellis Encoding Does Not Add A "Parity Signal" Cannot Preclude Infringement Of Claim 7 Of The '310 Patent

TPV proffered another non-infringement theory that applies only to claim 7 of the '310 patent: that the accused products do not infringe because a "parity signal" is not added to the digital signal. That theory also fails as a matter of law. Claim 7 does not require the error correction signal to be a parity signal. The absence of a parity signal thus cannot sustain the jury verdict. *Moba*, 325 F.3d at 1313-1314.

Claim 7 of the '310 patent requires an "error correction signal added commonly to both the video signal and the audio signal." A186(col.19:3-5). Wechselberger agreed that trellis encoding occurs and that trellis encoding is a form of "error correction." A8900, A8904-A8905. He also testified that trellis encoding provides redundancy by "adding something extra to the basic information, the basic message." A8900-A8901. He explained that trellis encoding works by changing two bits of information into three bits, which can then be restored to the original two bits by removing the encoding. A8907-A8910, A9007.

Wechselberger opined, however, that claim 7 is not infringed because "trellis encoding does not generate a parity signal." A8924. Discussing Figure 1

of the specification—which contains a circuit 24, labeled "parity addition," A159—Wechselberger explained that it shows "audio and video compressors feeding their information directly into a parity adder." A8923. He also testified that parity addition is the only type of error correction disclosed in the patent:

> [T]here's very little disclosed about the actual function of the error correction technology in -- in this patent. . . .
>
> *There's a box in the diagram that says parity-adder*. Parity-adders can be extremely simple. In fact, most of the time, they usually are. *So that's all we know is what the patent gives us.* And it shows a couple of particular types of approaches to parity addition.
>
> But as I went over with respect to the ATSC system, that requires a lot more than just parity addition, and *there's nothing supplied in this patent that -- that provides anything more than simple parity*.

A8921 (emphasis added).

Wechselberger then explained that the accused products do not infringe claim 7 because trellis encoding does not involve adding a parity signal:

> Q. Now, did you hear Mr. Hamilton testify that this added commonly limitation is met by trellis encoding?
>
> A. Yes. . . .
>
> Q. And do you agree with that?
>
> A. I do not agree with that.
>
> Q. And why not?

> A. . . . . [T]rellis encoding does not generate a parity signal. It does not add a parity signal to the signal that's being transmitted.
>
> The claim[] says parity is added. The name of the game is the claims. That doesn't happen here. No error correction signal is commonly added.

A8923-A8924.

Indeed, Wechselberger contrasted Reed-Solomon encoding (which meets the "separately added" limitation of the '375 patent claims) with trellis encoding, explaining that Reed-Solomon encoding involves a parity signal whereas trellis encoding does not. He testified: "Reed-Solomon is a parity-adder process. . . . Trellis is different. Trellis . . . transforms the information into something different. It doesn't have a parity signal. There's no parity addition that takes place." A8913.

But claim 7 simply does not require the addition of a parity signal. It requires only an "error correction signal added commonly to both the video signal and the audio signal." A186(col.19:3-5). Nothing in the claims requires the error correction signal to be a parity signal.

Wechselberger's acknowledgement that the signal is trellis encoded and that trellis encoding is error correction should have been the end of the matter. *Broadcom*, 732 F.3d at 1333. No reasonable jury could have found that trellis encoding fails to satisfy the "error correction signal" limitation in claim 7.

* * *

Once TPV's evidence relating to limitations not in the claims is set aside, the undisputed evidence establishes infringement of the asserted claims of the '375 and '310 patents. Denial of Hitachi's motion for judgment as a matter of law should be reversed. In the alternative, and at a minimum, Hitachi should be granted a new trial on these claims because the jury's verdict was against the great weight of the evidence.

III. JUDGMENT OF INFRINGEMENT AS A MATTER OF LAW SHOULD HAVE BEEN GRANTED ON THE '243 PATENT CLAIMS BECAUSE THE SCALER AND DEINTERLACER IN THE ACCUSED PRODUCTS ARE VIDEO PROCESSOR SECTIONS

The district court also erroneously denied judgment of infringement as a matter of law with respect to claims 4 and 5 of the '243 patent. There was no dispute at trial about how the accused devices operate. The accused products all have a scaler and a deinterlacer that process the video signal. TPV's expert opined, however, that the scaler and deinterlacer did not constitute "video processor sections" because they do not each take into account both the number of lines and whether the signal is interlaced or progressive. Because the claims contain no such requirement, that testimony cannot defeat infringement. *Moba*, 325 F.3d at 1313-1314.

The asserted claims of the '243 patent recite a digital receiver that can receive and process video signals within a digital multiplexed signal. Claim 1,

from which the asserted claims depend, contains four elements: (1) an isolator to isolate a video signal from a multiplexed signal, (2) a decoder to decode the video signal, (3) a plurality of video processor sections to provide video processing, and (4) a controller to determine the video signal format and select a video processor section. A259(col.7:31-45). Asserted claim 4 requires that the plurality of video processor sections be provided via at least one of a common ASIC and a common microprocessor. A259(col.7:57-62). And asserted claim 5 requires that the selection by the controller be performed by selectively performing processing with respect to one video processor section but not other video processor sections. A259(col.7:63-67).

It is undisputed that all of the accused products have the isolator, decoder, and controller required by the asserted claims. A8117-A8157, A8151-A8157, A8169-A8174, A8185-A8197 (Myler); A8837-A8838 (Reader). TPV's non-infringement defense depended on their expert's assertion that the accused products did not possess the "plurality of video processor sections" recited in the claims. A8837-A8838 (Reader). That element recites: "a plurality of video processor sections, with respective video processor sections providing video processing according to a different video signal format of said plurality of different video signal formats." A259(col.7:35-38). The district court construed "video

processor sections" and "processing" as having their plain and ordinary meanings. A41-A45.

Hitachi asserted that the products' scalers and deinterlacers satisfied the "plurality of video processor sections" limitation. A8175 (Myler). It is undisputed that each accused device has a scaler and a deinterlacer. A8175 (Myler); A8849-A8850, A8857-A8858 (Reader). It also is undisputed that the scaler and deinterlacer each provide video processing of received signals of different formats, such as 480i, 720p, and 1080i. A8177 (Myler); A8869-A8870 (Reader). When the picture in the incoming signal has a different number of scan lines than the television's display, the scaler processes the signal, adjusting the picture to match the television's display size. A8138, A8181 (Myler); A8866 (Reader). For example, if the television has 1080 scan lines and the format of the broadcast signal is 480i or 720p, the scaler will process the signal, expanding the picture to 1080 lines. A8181 (Myler); A8866 (Reader). The deinterlacer processes signals that are in an interlaced format, i.e., 1080i or 480i, converting them to progressive format for display. A8136, A8177-A8180 (Myler).

The claims require only that the video processor sections provide processing "*according to* a different video signal format." A259(col.7:37) (emphasis added). Hitachi's expert, Myler, explained that the scaler and deinterlacer each do that. The scaler "processes according to a different video signal format" because, for a

480p signal, the scaler "would operate to scale the 480 up to 1080," whereas "[o]n the 720p, the scaler would take 720 and scale it to 1080." A8181. The deinterlacer also processes according to different video signal formats: if "the display screen is 1080p, then the de-interlacer operates differently for each of those input formats. For an input interlace signal, for example, the 1080i, the de-interlacer must process the signal to make it match the 1080p display. For an input progressive signal 720p, the de-interlacer does not process the signal." A8178. Thus, each signal is processed according to its video format to provide the correct signal for display.

TPV's expert, Reader, nevertheless opined that the accused products do not infringe. In Reader's view, the televisions must have multiple video processor sections, *each* of which must separately take into account both the number of scan lines and the interlaced/progressive state of the signal at its input. Reader opined that the deinterlacer is not a video processor section "because it doesn't process according to both the number of lines and whether the -- the lines are interlaced or progressive." A8858. And he testified that the scaler is not a video processor section because it "is just concerned with the number of scan lines" and "has nothing to do with whether the lines are progressive or interlaced." A8856. Reader thus opined that "neither the scaler taken alone nor the de-interlacer taken alone can meet the Court's construction of what a video processor section must be." A8855.

But the district court did not so constrain "what a video processor section must be," much less give it the constricted construction represented by Reader. Reader's only basis for non-infringement thus goes to limitations not present in the claims and cannot, as a matter of law, sustain the jury verdict. *Moba*, 325 F.3d at 1313-1314; *Integra*, 496 F.3d at 1341-1342. Contrary to Reader's assertion, the court gave the "video processor sections" clause its plain and ordinary meaning. A45. The court also gave "processing" its plain and ordinary meaning. A44. Under the plain and ordinary meanings of "video processor sections" and "processing," each video processor section simply must process the video signal according to a format. There is no requirement that it process by using each distinct characteristic of a format.

To support his assertions, Reader invoked the district court's construction of "video signal format" as meaning "number of scan lines and whether the lines are progressive or interlaced." A46-A49. Reader plugged this construction into the "video processor sections" clause and then asserted that each video processor section thus must address *both* the number of scan lines and whether the lines are progressive or interlaced. A8844, A8855, A8858.

But just because a video signal format includes information about the number of scan lines and whether they are progressive or interlaced, it does not at all follow that providing video processing "according to" a format requires both

distinct characteristics to be used in the processing. The claimed receiver's controller determines the video signal format of the incoming signal and decides what processing is needed "according to" the determined format. A259(col.7:39-45). The scaler and deinterlacer each provide processing "according to" the determined signal format to provide the necessary output. A8177-A8182, A8189-A8190.

Reader improperly conflated the video processor sections with the controller. The nature of the processing that is done by the video processor sections is not specified in the claim. Rather, the claim simply recites that processing be done "according to" a video format. A259(col.7:37). The controller determines the format and selects the appropriate video processor section based on the determination. That is precisely what is done in the accused products. Based upon a determined format of, e.g., 720p or 1080i, the appropriate processor is selected.

In nevertheless denying Hitachi's motion for judgment as a matter of law, the district court reasoned that "Dr. Reader properly applied the Court's construction of 'video signal format,'" stating that "[f]or terms that are given their plain and ordinary meaning, the jury is free to apply an expert's description of the claims if it is consistent with the jury's understanding." A153. But this is hardly a situation of a jury applying a "plain and ordinary meaning" to a term. Instead, it is

a substitution of a requirement of plural elements for a singular expression contained in the claim.

Indeed, Reader's testimony that "processing" according to "a" video signal format requires using both the number of lines and interlaced/progressive state is contrary to the district court's correct construction of "processing." The district court construed "processing" to encompass other forms of processing, not only scaling and deinterlacing. A41-A44. In fact, relying on the first embodiment's disclosure, TPV actually argued at claim construction that "processing" is limited to "conversion into an appropriate analog video signal" and thus does not encompass scaling or deinterlacing at all. A41; A1592-A1593. Hitachi agreed that conversion to an analog signal is a form of processing but argued that the claims are not limited only to that particular limitation. A41-A42; A837-A838. The district court agreed with Hitachi and gave "processing" its ordinary meaning. A44. That meaning is not limited to processing based on multiple distinct characteristics.

Just as in *Moba*, the district court erroneously denied judgment as a matter of law by effectively "allow[ing] the jury to add an additional limitation to the district court's construction." 325 F.3d at 1313-1314. Once TPV's evidence relating to limitations not found in the claims is set aside, the undisputed evidence establishes infringement of the asserted claims of the '243 patent. Judgment of

infringement as a matter of law should be ordered. In the alternative, a new trial is warranted because the non-infringement verdict is against the great weight of the evidence.

IV. AT A MINIMUM, A NEW TRIAL ON INFRINGEMENT ON ALL FOUR PATENTS IS WARRANTED BECAUSE THE DIGICIPHER DOCUMENT PREJUDICED HITACHI'S INFRINGEMENT CASE

If judgment of infringement is not ordered, a new trial on infringement of the '243, '310, '375, and '497 patent claims is warranted because of the erroneous admission of the DigiCipher document.

The district court denied Hitachi's new trial motion based solely on its conclusion that "the DigiCipher reference [was] prior art and properly admitted in this case." A145. But if the invalidity judgment is reversed because the DigiCipher document is not prior art (*supra* Part I), the district court's denial rests on legal error. Such an error of law constitutes an abuse of discretion. *TWM Mfg. Co. v. Dura Corp.*, 789 F.2d 895, 898 (Fed. Cir. 1986).

Once the premise of the district court's denial is set aside, it is clear that a new trial is warranted. A new trial is required where prejudicial evidence was erroneously admitted. *Muñoz v. State Farm Lloyds*, 522 F.3d 568, 572-574 (5th Cir. 2008). To show prejudice, Hitachi need show only a reasonable likelihood that the improper admission affected its substantial rights, not that the trial would have turned out differently. *Johnson*, 609 F.2d at 823.

That holds true even if the DigiCipher document was conditionally admissible, contingent on TPV's ability to prove it was prior art. A new trial is required where prejudicial or confusing evidence initially was admissible but "later becomes irrelevant when one or more claims is rejected as a matter of law." *Cham v. Station Operators, Inc*., 685 F.3d 87, 97 (1st Cir. 2012); *see MacPherson v. University of Montevallo*, 922 F.2d 766, 772, 777 (11th Cir. 1991).

That standard is met here. The erroneous admission of the DigiCipher document was prejudicial and confused the jury. The evidence of infringement was overwhelming. TPV's experts admitted that TPV's televisions have the elements of the asserted claims. To avoid infringement, TPV's experts had to devise unsupported limitations not found in the claim language. Indeed, Hitachi's infringement case was so strong that the district court ruled that Hitachi had met the objective prong for willful infringement. A9160.

Nevertheless, after being instructed that "[i]nvalidity is a defense to patent infringement," A9170-A9212 at A9181, the jury found the claims not infringed. That the DigiCipher document loomed large in the jury room cannot be doubted. During deliberations, the jury asked a single question: it requested the DigiCipher document. A9267.

That request reflects the key role the DigiCipher document played in TPV's trial theme, on both infringement and invalidity. Whether Hitachi participated in

creation of the ATSC standard has nothing to do with whether TPV infringed the asserted claims, yet TPV argued it could not be liable because Hitachi was not involved in developing that standard. In his opening statement, TPV's counsel argued that "something ground-breaking happened" when General Instrument submitted the DigiCipher document, an all-digital proposal, to the FCC. A7922. TPV asserted that the DigiCipher document signaled a switch to digital, and that all the all-digital proposals thereafter were submitted by "United States companies. The Japanese companies fell to the wayside." A7922.

TPV's counsel further asserted that at the FCC's request, seven American companies formed the Grand Alliance and developed the ATSC standard. A7923. According to TPV, the fact that Hitachi was not part of the Grand Alliance defeated Hitachi's infringement theory:

> Hitachi wants to claim credit for the work that the Grand Alliance and those seven U.S. companies did in creating the ATSC standard.
>
> . . . [T]hey claim their patents are necessary or essential to -- to using the ATSC standard for modern televisions in the United States.
>
> I'm here to tell you it's simply not the case. It's simply not the case. They cannot come in here and take credit for the work that was done. What is it that those engineers half a world away in Japan were actually inventing, if anything?

A7924.

The introduction of the DigiCipher document enabled TPV to make these arguments. The DigiCipher system was the first all-digital proposal submitted to the FCC and is what initiated the formation of the Grand Alliance to develop the ATSC standard. The DigiCipher document was therefore key to TPV's theme that Hitachi's patents were not infringed because Hitachi did not develop the standard.

TPV carried forward this "Hitachi didn't invent" theme throughout Hitachi's infringement case-in-chief. When cross-examining Hitachi's expert, Hamilton, about infringement, TPV's counsel highlighted that Hitachi did not develop the ATSC standard: "You would agree with me that Hitachi was not a member of that group [the Grand Alliance], true?" A8389. TPV repeatedly injected concepts of inventorship during questions about infringement. A8366 ("Now, you would agree with me that Hitachi was not inventing receivers in either the '310 or the '375 patent, correct?"); A8368 ("You would agree with me that Hitachi didn't invent demodulators, correct?"); A8369 ("You would agree with me that Hitachi did not invent trellis decoders, correct?"); A8381 ("You would agree with me that Hitachi did not invent de-interleavers, correct?").

This line of questioning persisted during TPV's questioning of its own expert concerning infringement. A8895 ("Was Hitachi part of the Grand Alliance?"); A8896 ("Did Hitachi play any role in the development or adoption of the ATSC Standard?"); A8917 ("So was the use of error correction or compression

something that Hitachi had invented?"); A8918 ("Hitachi did not invent error correction."); A8919 ("Hitachi did not invent bit expansion of compressed digital or audio signals."). Indeed, Wechselberger testified: "So if anything is the backbone of the ATSC standard, it's not these three Hitachi patents." A8896.

Moreover, TPV tied the DigiCipher document to Hitachi's infringement expert, Hamilton. During Hitachi's infringement case-in-chief, long before invalidity was supposed to come up, TPV displayed the DigiCipher document on a large screen for the jury and began questioning Hamilton about it. A8336-A8357. When Hitachi objected, the district court noted that TPV "precipitate[d] jury confusion" by injecting invalidity issues into the infringement case. A8356.

Finally, TPV's own statements confirm the importance of the DigiCipher document to TPV's non-infringement argument. TPV argued to the court that the DigiCipher document "went directly to issues of non-infringement and invalidity of the Patents-in-suit." A9548. And after trial, TPV's counsel told a legal reporter that TPV's strategy was to convince the jury that Hitachi "didn't contribute anything to the [ATSC] standard." A9699.

On these facts, where the issues of invalidity and infringement are so intertwined, if the invalidity portion of the verdict is set aside (as it should be), the non-infringement portion also should be set aside and a new trial granted. It is only appropriate to leave intact a portion of the verdict if "it is plain that the error

which has crept into one element of the verdict did not in any way affect the determination of any other issue." *Pryer v. C.O. 3 Slavic*, 251 F.3d 448, 455 (3d Cir. 2001); *see Gasoline Prods. Co. v. Champlin Ref. Co.*, 283 U.S. 494, 500 (1931) (issues not separable where, to determine damages for a breach of contract on remand, the jury might need to revisit issues pertaining to liability); *see also Witco Chem. Corp. v. Peachtree Doors, Inc.*, 787 F.2d 1545, 1549 (Fed. Cir. 1986); *Williams v. Slade*, 431 F.2d 605, 609 (5th Cir. 1970).

Here, there is a significant chance that the DigiCipher document tainted the infringement portion of the verdict. Hitachi was entitled to an infringement trial uncontaminated by the DigiCipher document. Hitachi did not get one. If the Court reverses the denial of judgment as a matter of law on validity (or grants a new trial because the verdict was against the weight of the evidence), but does not reverse the denial of judgment as a matter of law on infringement as to any asserted claim, the Court should remand for a new trial on infringement.

CONCLUSION

Judgment of non-invalidity of the asserted '375 and '310 patent claims should be ordered, as well as judgment of infringement of the asserted '375, '310, and '243 patent claims. In the alternative, a new trial should be ordered on the asserted '243, '310, '375, and '497 patent claims.

Respectfully submitted,

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s/ Deanne E. Maynard

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ADDENDUM

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

HITACHI CONSUMER ELECTRONICS CO. LTD., et al., *Plaintiffs,*	§	
	§	**CAUSE NO. 2:10-CV-260-JRG**
V.	§	
TOP VICTORY ELECTRONICS (TAIWAN) CO LTD, et al., *Defendants.*	§	

MEMORANDUM OPINION AND ORDER

Before the Court are the parties' post-trial motions. Having considered the parties' written submissions, the Court: (1) **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the '310 and '375 Patents are Infringed or, Alternatively, for a New Trial Pursuant to Rule 59(a) (Dkt. No. 359); (2) **DENIES** Hitachi's Motion Pursuant to Rule 59 For a New Trial on All Issues Due to Submission of False Testimony and Improper Argument (Dkt. No. 360); (3) **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the DigiCipher Reference is not Prior Art, that the '310 and '375 Patents are Not Invalid, and for a New Trial With Respect to All Issues on the '310 and '375 Patents (Dkt. No. 361); and (4) **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the '243 Patent is Infringed or, Alternatively, for a New Trial Pursuant to Rule 59(a) (Dkt. No. 362).

I. BACKGROUND

Hitachi Consumer Electronics Co., Ltd. and Hitachi Advanced Digital, Inc. (collectively, "Hitachi") filed this patent infringement action against Top Victory Electronics (Taiwan) Co. Ltd.,

TPV International (USA), Inc., Envision Peripherals, Inc., Top Victory Electronics (Fujian) Co. Ltd., and TPV Technology Ltd. (collectively, "TPV") and Vizio, Inc. ("Vizio") on July 22, 2010. Hitachi alleges TPV and Vizio infringe the following patent claims by importing and selling televisions compliant with the ATSC A/53 standard: Claim 7 of U.S. Patent No. 7,286,310 ("the '310 patent"), claims 26 or 30 of U.S. Patent No. 8,009,375 ("the '375 patent"), claims 15 or 16 of U.S. Patent No. 5,502,497 ("the '497 patent"), and claims 4 or 5 of U.S. Patent No. 6,549,243 ("the '243 patent"). Hitachi resolved its case against Vizio before jury selection and went to trial against TPV on April 8, 2013. Following a five day trial, the jury returned a unanimous verdict finding that TPV does not infringe any of the asserted claims. The jury also found that claim 7 of the '310 patent and claims 26 and 30 of the '375 patent are invalid. (*See* Dkt. No. 335.)

II. APPLICABLE LAW REGARDING RULE 50

Judgment as a matter of law is only appropriate when "a reasonable jury would not have a legally sufficient evidentiary basis to find for the party on that issue." Fed. R. Civ. P. 50(a). "The grant or denial of a motion for judgment as a matter of law is a procedural issue not unique to patent law, reviewed under the law of the regional circuit in which the appeal from the district court would usually lie." *Finisar Corp. v. DirectTV Group, Inc.*, 523 F.3d 1323, 1332 (Fed. Cir. 2008). The Fifth Circuit "uses the same standard to review the verdict that the district court used in first passing on the motion." *Hiltgen v. Sumrall*, 47 F.3d 695, 699 (5th Cir. 1995). Thus, a jury verdict must be upheld, and judgment as a matter of law may not be granted, unless "there is no legally sufficient evidentiary basis for a reasonable jury to find as the jury did." *Id.* at 700. The jury's verdict must be supported by "substantial evidence" in support of each element of the claims. *Am. Home Assurance Co. v. United Space Alliance*, 378 F.3d 482, 487 (5th Cir. 2004).

A court reviews all evidence in the record and must draw all reasonable inferences in favor of the nonmoving party; however, a court may not make credibility determinations or weigh the evidence, as those are solely functions of the jury. *See Reeves v. Sanderson Plumbing Prods., Inc.*, 530 U.S. 133, 150-51 (2000). The moving party is entitled to judgment as a matter of law "only if the evidence points so strongly and so overwhelmingly in favor of the nonmoving party that no reasonable juror could return a contrary verdict." *Int'l Ins. Co. v. RSR Corp.,* 426 F.3d 281, 296 (5th Cir. 2005).

III. APPLICABLE LAW REGARDING RULE 59

Under Rule 59(a) of the Federal Rules of Civil Procedure, a new trial can be granted to any party to a jury trial on any or all issues "for any reason for which a new trial has heretofore been granted in an action at law in federal court." Fed. R. Civ. P. 59(a). "A new trial may be granted, for example, if the district court finds the verdict is against the weight of the evidence, the damages awarded are excessive, the trial was unfair, or prejudicial error was committed in its course." *Smith v. Transworld Drilling Co.*, 773 F.2d 610, 612-13 (5th Cir. 1985). The Court must view the evidence "in a light most favorable to the jury's verdict, and [] the verdict must be affirmed unless the evidence points so strongly and overwhelmingly in favor of one party that the court believes that reasonable persons could not arrive at a contrary conclusion." *Dawson v. Wal-Mart Stores, Inc.*, 978 F.2d 205, 208 (5th Cir. 1992).

IV. HITACHI'S MOTION FOR JUDGMENT AS A MATTER OF LAW PURSUANT TO RULE 50(B) THAT THE '310 AND '375 PATENTS ARE INFRINGED OR, ALTERNATIVELY, FOR A NEW TRIAL PURSUANT TO RULE 59(A) (DKT. NO. 359)

Hitachi moves for judgment as a matter of law pursuant to Federal Rule of Civil Procedure 50(b) that TPV infringes claim 7 of the '310 patent and claims 26 and 30 of the '375 patent (the

"Disputed Claims"). Hitachi urges the Court to reverse the jury's verdict as to these claims because (1) Hitachi has made a *prima facie* case that the ATSC televisions ("TVs") met each and every claim element, (2) TPV's non-infringement arguments were legally flawed, and (3) TPV made irrelevant arguments to confuse the jury. Alternatively, Hitachi requests a new trial on these claims pursuant to Rule 59(a).

A. Hitachi's *prima facie* case of infringement

At trial, Hitachi accused 242 models of TVs of literally infringing claim 7 of the '310 patent and claims 26 and 30 of the '375 patent because they are configured to receive and display signals broadcast in accordance with the ATSC standard.[1] The Disputed Claims encompass an apparatus comprising a receiver, a demodulator, an error corrector, a first expander for digital video content, and a second expander for digital audio information. Hitachi contends that it has presented sufficient evidence through its technical expert, Mr. Jeffrey Hamilton, to prove the accused ATSC TVs possessed each and every element of the Disputed Claims. (Dkt. No. 359 at 5-6.) Specifically, Hitachi contends Mr. Hamilton explained that TV signals broadcast in accordance with the ATSC standard includes video information compressed using the MPEG-2 video compression standard and audio information compressed using the AC-3 audio compression standard. Mr. Hamilton further testified that once the broadcast signals were received, the accused television receivers used MPEG-2 and AC-3 decoders to bit-expand the video and audio signals. In expanding the video and audio signals, Mr. Hamilton described, the decoders necessarily expanded the signal corrected by the error corrector to recover the picture.

In response, TPV argues that Hitachi's infringement analysis focused on pieces of claim limitations that recite certain components (*i.e.*, "receiver," "demodulator," "error corrector," "two

[1] Hitachi did not allege infringement of any limitation under the Doctrine of Equivalents.

bit expanders"), but ignored other claim language that specify how those components are interconnected. For example, TPV points to the relationship in claim 7 of the '310 patent that requires "a first expander which bit-expands the video signal of the digital signal corrected by the error corrector in accordance with the first compression method" and "a second expander which bit-expands the audio signal of the digital signal corrected by the error corrector in accordance with the second compression method." However, TPV argues, Mr. Hamilton does not explain the correlation between the first and second expanders and their particular operation on corresponding signals. Instead, he merely testified that in an accused product, the "first expander" limitation is satisfied because "MPEG decoder can receive a signal from an error corrector [and that the] error correction must be performed before you can do the bit expansion," and the "second expander" limitation is satisfied because "audio is compressed [and] expanding [] must be done. (4/9/2013 AM Tr. at 121:10-16 and 122:2-123:6.)

TPV additionally asserts that Hitachi failed to put forth a *prima facie* case as to any of the 242 models of accused TVs or 20 different accused chipsets. Rather than showing how any single one of the accused products or chipset meets all the limitations of the asserted claims, TPV argues Mr. Hamilton mixed and matched different chipset datasheets and standard documents to address different elements of the same asserted claim. In reply, Hitachi explained that due to the number of accused products, and since infringement was predicated on compliance with the ATSC standard, Mr. Hamilton properly relied on a set of documents that were representative of all the accused products.

The burden to prove patent infringement was on Hitachi to "show that the accused device[s] contain[] each limitation of the asserted claim." *Function Media, L.L.C. v. Google, Inc.*,

708 F.3d 1310, 1330-31 (Fed. Cir. 2013). In considering Hitachi's motion, the Court "must consider all the evidence in a light most favorable to [the prevailing party], must draw reasonable inferences favorable to [the prevailing party,] must not determine credibility of witnesses, and must not substitute its choice for that of the jury between conflicting elements in the evidence." *Perkins-Elmer Corp. v. Computervision Corp.*, 732 F.2d 888, 893 (Fed. Cir. 1984). The Federal Circuit is clear that "[c]ourts grant JMOL for the party bearing the burden of proof only in extreme cases, when the party bearing the burden of proof has established its case by evidence that the jury would not be at liberty to disbelieve and the only reasonable conclusion is in its favor." *Mentor H/S, Inc. v. Med. Device Alliance, Inc.*, 244 F.3d 1365, 1375 (Fed. Cir. 2001).

The record does not support a finding that this is such a rare case. The Court is persuaded that the jury could have found Hitachi failed to show the accused products met each limitation of each asserted claim. The jury was also at liberty to disbelieve Mr. Hamilton's infringement testimony, or find the selection of documents was not representative of all the accused products. While it is unclear whether the verdict of no infringement results from the jury's determination that Hitachi failed to make a *prima facie* case of infringement or is based on TPV's successful rebuttal evidence if a *prima facie* case was initially made, the Court concludes that based on the evidence presented at trial, a reasonable jury would not have been foreclosed from finding Hitachi failed to meet its burden of proof.

B. TPV's non-infringement arguments

Hitachi asserts the non-infringement arguments advanced by TPV's expert, Mr. Anthony Wechselberger, are improperly predicated on the fact that the accused products include additional components other than those recited in the asserted claims. Hitachi particularly takes issue with

Mr. Wechselberger's account of additional processing by unclaimed circuit elements (such as the deinterleaver, Reed-Solomon decoder, derandomizer, and de-multiplexer that are present in the accused devices), which take place between the error corrector and the bit expanders. Mr. Wechselberger uses the additional components to form his opinion that the output signal from the error corrector and the input signal to the bit-expander are not the same signal, as the asserted claims require. Hitachi contends this type of analysis is legally flawed and is irrelevant to the issue of infringement.

TPV responds that Mr. Wechselberger did not premise his opinion on additional elements within the accused TVs which would prevent infringement. Instead, he educated the jury about how the accused products operate pursuant to the ATSC standard by analyzing the claim language and explaining how each of the claimed components must be interconnected to meet the claim limitations. (4/11/2013 AM Tr. at 89:17-129:7; 4/11/2013 PM Tr. at 11:6-14:19.) TPV says further that it is actually Hitachi who failed to address how the expander limitations must operate on particular signals in its infringement case. This is a situation, says TPV, where the jury assessed both experts' competing testimony, found Mr. Wechselberger's testimony to be more credible than Mr. Hamilton's testimony, and rendered a verdict in accordance therewith. Based on a review of the evidence, the Court agrees with TPV.

Hitachi and TPV took differing positions on how certain elements of a claim should be read on the accused products and presented expert witnesses who testified accordingly. For example, as described above, Hitachi argues the digital signal is necessarily the same signal even though it undergoes multiple error correction and coding steps, whereas TPV takes the position that the signal is not the same. Similarly, the opposing experts held divergent opinions on whether trellis

codes satisfy the "error correction signal added commonly to both the video signal and the audio signal" limitation of claim 7. (4/11/2013 AM Tr. at 98:2-104:1, 114:25-117:16.) The jury heard both sides' interpretation of the claim language, considered the experts' competing testimony, and rendered a verdict of no infringement. This is a classic case of the jury believing TPV's expert witness over Hitachi's expert witness. This Court may not effectively supplant the jury's assignment of credibility or weight attributed as between the experts, as those are sole functions of the jury. Whether the jury initially found that Hitachi established a *prima facie* case of infringement or not, the Court finds that a reasonable jury could have concluded Mr. Wechselberger's expert opinion sufficiently rebutted a *prima facie* showing of infringement. Therefore, the Court finds substantial evidence exists in the record to support a jury verdict that TPV does not infringe claim 7 of the '310 patent or claims 26 and 30 of the '375 patent.

C. Jury Confusion

Hitachi also contends it is entitled to judgment as matter of law of infringement because TPV engaged in irrelevant arguments to confuse the jury as to Hitachi's infringement case. Hitachi points to three instances of alleged misconduct: (i) Mr. Wechselberger's testimony that if certain components were removed, the accused products would not work; (ii) TPV's implication to the jury that the asserted claims were limited to video tape recorders (VTRs); and (iii) injecting DigiCipher into Hitachi's case-in-chief on infringement.

In its opposition, TPV first responds that its "will not work" argument was only used to show that the accused products could not practice the asserted claims if they were redesigned to fit within the asserted claims. For example, TPV explained, if the "first expander" and "second expander" were reconfigured to receive the particular signals as required by the claims, the

accused products would not work. Hitachi's own expert, Mr. Hamilton, agreed such is the case. (4/9/2013 PM Tr. at 85:9-87:9.)

Second, TPV asserts it only discussed VTRs to provide a background of the alleged invention after Hitachi first mentioned VTRs through testimony from Mr. Hamilton. (4/9/2013 AM Tr. at 86:5-6.) The burden is on Hitachi to prove by a preponderance of the evidence that the accused systems infringe its asserted patents. If TPV presented evidence Hitachi disputes or finds improper, the burden shifts to Hitachi to cross-examine the witness on the correctness or relevance of such testimony. Hitachi had a full and fair opportunity to cross-examine TPV's witnesses at trial and, in fact, did cross-examine Mr. Wechselberger on some of the very issues about which it now complains. Specifically, Hitachi asked Mr. Wechselberger if he is "aware of any Court claim construction that limits the claims in suit to videotape recorders?" to which Mr. Wechselberger answered "No." (4/11/2013 PM Tr. 62:20-63:2.) Hitachi then called Mr. Hamilton a second time during its rebuttal case to reinforce its infringement theory and specifically refute Mr. Weschselberger's testimony on the issue of "the same signal" and "additional elements" discussed above. (4/12/2013 AM Tr. at 4:19-9:9.) As is often the case, disputed theories at trial tend to become more apparent in post-trial briefing. However, the clarity of hindsight does not lessen Hitachi's burden of proof at trial. Hitachi cannot be entitled to judgment as a matter of law simply because it failed to clearly identify or effectively rebut its adversary's position during trial.

With respect to Hitachi's third point on TPV's use of the DigiCipher during the questioning of Mr. Hamilton, the Court held a bench conference once Hitachi raised this objection. As it became clear that the issue could not be addressed expeditiously at the bench, the Court excused the jury so the parties could have a full and fair opportunity to discuss and attempt to

resolve the issue. (4/9/2013 PM Tr. at 41:5-45:3.) Once both sides were fully heard, the Court found Defendants did not take any improper steps by presenting the DigiCipher reference because it was a pre-admitted exhibit and Hitachi's motion *in limine* to preclude the reference was previously denied. (*Id.* at 45:9-51:19.) Nevertheless, in an effort to avoid jury confusion, the Court directed TPV to refrain from substantive testimony relating to DigiCipher until its invalidity case. (*Id.* at 51:22-55:5.) The Court's directive was obeyed. However, insofar as Hitachi's current complaint relates to the answers elicited by TPV before Hitachi made an objection, and absent any evidence of jury confusion, the Court finds the jury was not confused by the short testimony providing essentially background information.

The jury heard the evidence presented by both sides and the Court's unambiguous instruction regarding the proper method for conducting an infringement analysis before returning a verdict of non-infringement. (4/12/2013 PM Tr. at 31:1-12.) Absent compelling evidence pointing so overwhelmingly in favor of Hitachi that no reasonable jury could return a contrary verdict (which was not presented at trial), the Court concludes that the jury chose to believe or disbelieve the testimony they heard as a part of weighing all the evidence and then reaching their verdict in this regard. *RSR Corp.*, 426 F.3d at 296. Accordingly, the Court does not find an insufficient evidentiary basis for a reasonable jury to find as this jury did in this case. Similarly, the Court does not find the verdict to be so against the weight of the evidence as to warrant a new trial.

D. Conclusion

Based on the foregoing, the Court **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the '310 and '375 Patents are Infringed or, Alternatively, for a New Trial Pursuant to Rule 59(a) (Dkt. No. 359).

V. HITACHI'S MOTION PURSUANT TO RULE 59 FOR A NEW TRIAL ON ALL ISSUES DUE TO SUBMISSION OF FALSE TESTIMONY AND IMPROPER ARGUMENT (DKT. NO. 360)

Hitachi moves for a new trial under the Federal Rule of Civil Procedure 59 based on (1) alleged false testimony by Mondy Houng that denied Hitachi a fair trial, and (2) TPV's reliance on DigiCipher to show that the jury's verdict was tainted by evidence that Hitachi acted as a bully toward TPV. "A new trial may be granted, for example, if the district court finds the verdict is against the weight of the evidence, the damages awarded are excessive, the trial was unfair, or prejudicial error was committed in its course." *Transworld Drilling*, 773 F.2d at 612-13. Hitachi's primary basis for both of its arguments for a new trial is based on principles of unfairness.

A. Mondy Houng's testimony

The background for Hitachi's current allegation stems from an April 13, 2010 mediation between Hitachi and TPV, during which TPV believes a threat was made by Hitachi that precipitated the declaratory judgment action brought by TPV against Hitachi in California. *Top Victory Electronics (Taiwan) Co., Ltd. v. Hitachi, Ltd.*, No. CV 10-1579 (N.D. Cal.) TPV's filing of the California action was intentionally placed front and center before the jury during opening statements in this case by both sides. Hitachi started by proclaiming it was "sucker punch[ed]" by TPV's California lawsuit "out of the blue" on April 14, 2010. (4/8/13 AM Tr. at 54:19-22.) TPV followed by telling the jury to look carefully through the evidence because there is a critical fact about a "pre-meeting lawsuit" that will be missing from Hitachi's story. (*Id.* at 81:7-18.) Reference to the April 13 mediation and whether or not it should be admissible testimony became a topic of much debate throughout trial, all of which occurred outside the presence of the jury. Ultimately, the Court sustained Hitachi's objections based on the mediation privilege and barred TPV from asking Mondy Houng, TPV's corporate representative, about the April 13, 2010 mediation for that

specific reason. Subsequently during direct examination, TPV's counsel asked Mr. Houng about a meeting that occurred on March 23, 2010:

> Q. And as part of your decision, on behalf of the company, to authorize the company in April, are you aware of what happened at that meeting on March 23rd, 2010?
>
> A. The report we got -- the reporting we got from the meeting was that **the Hitachi representative has threatened to cut down -- shut down our U.S. TV market during that meeting.**
>
> Q. Okay. Did -- did you know how they intended to shut down your business?
>
> A. They said -- **they said they would sue us in the International Trade Commission in United States**, and we're aware that U.S. International Trade Commission is different from court. It was very -- it has a high risk for us.

(4/10/2013 PM Tr. at 107:11-25 (emphasis added)). Hitachi now contends that when the Court prevented TPV from going into the April 13 mediation, Mr. Houng unilaterally moved the date of the meeting to March 23 to circumvent the Court's ruling and fabricated a threat that did not exist. As support for its position, Hitachi points to a statement in a brief TPV filed in the California action that "[t]here is no evidence that TPV commenced this case in the face of specific, concrete indications that a suit by Hitachi in some other forum was imminent." (Dkt. No. 360 at 1.) This inconsistency between Mr. Houng's response and TPV's statement in California, according to Hitachi, proves that Mr. Houng's testimony in this Court was false. Hitachi submits that Mr. Houng's false testimony influenced the jury to believe TPV over Hitachi. Additionally, Hitachi contends such prejudice could not have been cured during trial because Charles Chen, the TPV employee who actually attended the March 23 meeting and reported to Mr. Houng, was not allowed to testify.

In its opposition, TPV responds that the sentence in the California brief was taken out of context and claims that it's not inconsistent with Mr. Houng's testimony. TPV explained that the above statement was made in response to Hitachi's claim that the action was an improper

anticipatory lawsuit filed to avoid litigating in the Eastern District of Texas. The emphasis in the statement was on the term "imminent" because, for a first-filed declaratory judgment action to be considered "anticipatory," there must have been a "specific, concrete" threat that a lawsuit was "imminent" in the forum the declaratory judgment plaintiff was trying to avoid. (Dkt. No. 368 at 6.) Reviewing the statement in the context of a response to Hitachi's motion, the Court finds such to be consistent with Mr. Houng's testimony here. In addition, the Court finds that neither statement precludes the existence of some kind of threat of suit by Hitachi. The Court also finds it not entirely unbelievable that multiple threats of suit, increasing in urgency, were communicated between Hitachi and TPV over the twelve month period they spent negotiating a license. Indeed, Hitachi has presented no evidence to the contrary.

A party seeking a new trial on the basis of allegedly false testimony must prove by clear and convincing evidence that: (i) the witness "willfully perjured himself," and (ii) the allegedly false testimony prevented the party from fully and fairly presenting its case. *Diaz v. Methodist Hosp.*, 46 F.3d 492, 496-97 (5th Cir. 1995). Hitachi's accusation is a serious one and its burden of proof is high, yet the strength and degree of Hitachi's allegations regarding the nature of Mr. Houng's testimony diminished significantly between its opening brief and its reply brief on this issue. (*Compare* Dkt. No. 360 at 1 ("That testimony was false") to Dkt. No. 373 at 1 ("Mr. Houng's testimony is seriously misleading if not downright untruthful.")). The standard for a new trial in this circumstance is not potentially misleading testimony, but rather willfully committing perjury. These are very different standards. Consequently, the Court finds Hitachi has failed to establish the first prong of the *Diaz* analysis and therefore, does not reach the second prong. Interestingly to the Court, although Hitachi was clearly aware of TPV's allegedly false statement

well before this trial, Hitachi chose not to use it to impeach Mr. Houng during cross-examination. Instead, Hitachi elected to raise it for the first time in a motion for new trial. This allegedly false statement of TPV is not a justifiable basis upon which to require the expenditure of the parties' and the Court's resources for a new trial.

B. The DigiCipher reference

Hitachi contends to have suffered prejudice by TPV's use of the DigiCipher reference to characterize Hitachi as a "schoolyard bully." (Dkt. No. 360 at 9.) To support its position, Hitachi points to statements made in TPV's opening and closing statements, cross-examination questions about DigiCipher during Hitachi's infringement case, and the importance presumed by the jury's request to see the DigiCipher reference during deliberations. However, when pressed, Hitachi's true complaint "is not with TPV counsel's closing argument, but rather with the underlying [] DigiCipher evidence on which it was based."[2] (Dkt. No. 373 at 4.) As the Court has concurrently found the DigiCipher reference to be prior art and properly admitted in this case, below, the Court likewise concludes that Hitachi was not prejudiced by the introduction or use of the DigiCipher reference by TPV.

C. Conclusion

Based on the foregoing, the Court **DENIES** Hitachi's Motion Pursuant to Rule 59 for a New Trial on All Issues Due to Submission of False Testimony and Improper Argument (Dkt. No. 360)

[2] Hitachi does not dispute that it failed to object or move for a mistrial on the ground of improper argument to the jury based on TPV's alleged arguments that DigiCipher caused bullying, the American invention theme, or argument that Hitachi did not contribute to the development of the ATSC standard.

VI. HITACHI'S MOTION FOR JUDGMENT AS A MATTER OF LAW PURSUANT TO RULE 50(B) THAT THE DIGICIPHER REFERENCE IS NOT PRIOR ART, THAT THE '310 AND '375 PATENTS ARE NOT INVALID, AND FOR A NEW TRIAL WITH RESPECT TO ALL ISSUES ON THE '310 AND '375 PATENTS (DKT. NO. 361)

Hitachi moves for judgment as a matter of law pursuant to the Federal Rule of Civil Procedure 50(b) that (1) DigiCipher is not prior art and does not invalidate the '310 patent, (2) there is no motivation to combine DigiCipher with U.S. Patent No. 5,070,503 to Shikakura ("Shikakura") to render the '375 patent obvious, and (3) TPV's exploitation of DigiCipher confused the jury and prejudiced Hitachi to entitle it to a new trial.

A. DigiCipher constitutes prior art

The DigiCipher reference (admitted as DX-599) is a printed document at the heart of TPV's invalidity case. It generally describes an all-digital HDTV system for over-the-air broadcast televisions. The document was created by the VideoCipher Division of General Instruments Corp. ("GI") and bears a date of June 8, 1990 on the first page. There is no dispute that the DigiCipher system found in DX-599 discloses all the elements of claim 7 of the '310 patent. Instead, the primary disagreement is over DigiCipher's qualification as prior art—specifically, whether or not it was publicly available prior to July 20, 1990, the priority date of the asserted patents. To demonstrate that it was not publicly available and is not prior art, Hitachi relies only on Mr. Scott Lery's testimony stating that he does not know *exactly* when the DigiCipher reference became publicly known.

In response, TPV points to Mr. Lery's testimony that he was given DX-599 upon arrival at GI in late June of 1990. (4/11/2013 AM Tr. at 8:12-17, 11:21-12:6.) Mr. Lery was hired at GI to build the DigiCipher system. (*Id.*) Mr. Lery testified that when he arrived at GI, DX-599 was already readily available to anyone within GI and that even Dr. Chris Heegard, an outside

consultant, had access to the system information contained in DX-599. (*Id.* at 12:12-20, 15:12-18.) DX-599 was not labeled or otherwise designated as confidential despite Mr. Lery's testimony that GI had a practice of marking proprietary information as confidential, and the document was not otherwise maintained or treated in a confidential manner. (*Id.* at 10:8-11:10.) Instead, Mr. Lery specifically recalled that the DigiCipher system was publicized by GI because he was given a Xeroxed copy of a press release about the same time he received the DigiCipher document. (*Id.* at 11:11-20.)

There is also evidence in the record that GI was the first company to submit an all-digital proposal to the Federal Communications Commission (FCC). For example, a former Hitachi employee, John Henderson, testified that he was a member of a working party tasked with reviewing proposals submitted to the FCC by various companies in the industry. (4/10/2013 PM Tr. at 137:6-139:24.) The working parties were made up of people who were interested in the process and chose to join. (*Id.*) Mr. Henderson testified that, as part of his duties, he listened to the presentation for the DigiCipher system, the first all-digital system submitted to the FCC. (*Id.*) GI's proposal for an all-digital, high-definition system to the ATSC was confirmed by Dr. Clifford Reader, TPV's expert witness. (4/11/2013 AM Tr. at 24:15-19.) This is further corroborated by Mr. Lery who testified that when he received DX-599, he was aware that a copy was in the possession of the government agency. (4/11/2013 AM Tr. at 15:4-21.)

Whether a reference is publicly accessible is determined on a case-by-case basis based on the "facts and circumstances surrounding the reference's disclosure to members of the public." *In re Klopfenstein*, 380 F.3d 1345, 1350 (Fed. Cir. 2004). The jury, as the trier of fact, was free to believe or disbelieve the testimony presented by the witnesses and to evaluate their credibility.

Taking the record as a whole, the jury could fairly weigh the evidence and reasonably infer that the DigiCipher system described in DX-599 was submitted to the FCC and seen by members of the interested public prior to July 20, 1990. The Court finds that a reasonable jury would have a legally sufficient evidentiary basis to find that Defendants met their clear and convincing burden to prove that the DigiCipher reference constitutes prior art in this case. As such, this prior art is adequate to invalidate the ’310 patent. These facts were found by the jury in this case and Hitachi has given the Court no compelling basis to obviate such jury finding.

B. Claims 26 and 30 of the ’375 patent are invalid as obvious

Hitachi moves the Court to supplant the jury’s verdict and instead, find claims 26 and 30 of the ’375 patent to be valid because, it argues, TPV failed to provide any reasons why one skilled in the art would be motivated to combine DigiCipher with Shikakura. Specifically, Hitachi argues Mr. Wechselberger’s explanation that both the Shikakura error corrector with DigiCipher references are in the same field of art does not explain why one of ordinary skill in the art would have the necessary motivation to combine the two references.

TPV responds by citing Mr. Wechselberger’s testimony comparing the disclosure in DigiCipher to the disclosure in Shikakura. (4/11/2013 PM Tr. at 26:19-27:16.) In his testimony, Mr. Wechselberger describes that both references relate to digital audio and video information, first and second error correcting circuits, similar types of processing functions, and transmission systems using similar types of digital information. (*Id.*) The difference, Mr. Wechselberger explains, is that DigiCipher disclosed adding error correction information *commonly* to both the audio and video information, and Shikakura taught that error correction could be added to the audio and video streams *separately*. (*Id.* at 21:20-22:16, 25:20-26:5.) Since the concept of adding

error correction information separately or commonly is known by persons of ordinary skill in the art, there exists a reasonable motivation to combine the two references. (*Id.* at 25:3-19.) The Court agrees and finds the record reflects that TPV provided substantial evidence for a motivation to combine DigiCipher with Shikakura, and doing so reasonably supports the jury's finding that the '375 patent is invalid as obvious.

Hitachi also argues that, even if one skilled in the art had a reason to make this combination, the claimed inventions in the '310 and '375 patents were still non-obvious in light of certain secondary considerations presented by Mr. Hamilton. Specifically, Mr. Hamilton testified that the claimed inventions are commercially successful, satisfied a long-felt and unmet need in the industry, and are included in 100% of all televisions sold in the U.S. (4/12/2013 AM Tr. at 24:12-28:10.) He further testified that the '310 and '375 patents were subject to multiple licensing agreements and enjoyed industry respect. (*Id.* at 26:1-27:14.) Hitachi contends these secondary considerations, which demonstrate the claimed inventions were non-obvious, remain un-rebutted by TPV. However, "a highly successful product alone would not overcome the strong showing of obviousness." *Tokai Corp. v. Easton Enterprises, Inc.*, 632 F.3d 1358, 1371 (Fed. Cir. 2011) (citing *Media Techs. Licensing, LLC v. Upper Deck Co.*, 596 F.3d 1334, 1339 (Fed. Cir. 2010)). In spite of Mr. Hamilton's testimony, the success of the claimed invention is debatable since the jury clearly did not find the '310 and '375 patents tied to 100% of all televisions sold in the U.S. Additionally, the jury heard testimony that Hitachi was not involved in developing the ATSC standard, which is the crux of Hitachi's infringement allegations. (4/10/2013 PM Tr. at 140:3-8, 142:4-144:25.) The finder of fact has considered the evidence presented by both sides, made a determination based on such evidence, and rendered its verdict. The Court has no basis from which

to find that the verdict lacks a sufficient evidentiary basis such that a reasonable jury could not have found as this jury did in this case.

C. TPV's use of DigiCipher

Hitachi re-urges its request for a new trial to ameliorate the asserted prejudice caused by TPV's use of the DigiCipher reference during trial. The Court previously addressed this argument in Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the '310 and '375 Patents are Infringed or, Alternatively, for a New Trial Pursuant to Rule 59(a) (Dkt. No. 359), and found the short background testimony given by Mr. Hamilton did not confuse the jury. In this motion, Hitachi now adds that TPV contaminated its infringement case by keeping an image of the DigiCipher reference on the projector screen during a bench conference. However, Hitachi was the party who made the objection and invoked the sidebar discussion. Hitachi did not ask for the image to be removed from the screen during such bench conference. Simply put, Hitachi re-urges its earlier prejudice argument by contending that the lengthy bench conference emphasized the importance of this document to the jury before they were ushered out of the courtroom. This is argument unpersuasive.

The Court comes to the same conclusion as it did before. The brief testimony, bench conference, and argument outside the presence of the jury relating to DigiCipher, while disruptive to the flow of trial, is a normal and inherent aspect of trial proceedings. While it is the Court's strong preference to address such disputes during pretrial hearings and during the morning hour that the Court specifically allocates for such issues, it is not uncommon to stop the presentation of evidence during trial and deal with issues as they arise outside the jury's presence. Indeed, the Court clearly instructed the jury:

> "[A]t times during the trial, it was necessary for the Court to talk to the lawyers here at the bench out of your hearing or by calling a recess and talking to them while you were out of the courtroom all together. We met because often during a trial something comes up that does not involve the jury. *You should not speculate on what was said during such discussions out of your presence*."

(4/12/2013 PM Tr. at 23:15-23 (emphasis added)). If every time the Court conducts a bench conference or sends the jury out of the courtroom it opens itself to claims of fostering unfairness or prejudice toward one side or the other, then the effective administration of justice would be severely hindered.

Hitachi's arguments of prejudice and jury confusion appear to be born out of little more than speculation. Indeed, the jury's request to see the DigiCipher exhibit during deliberations is not indicative of confusion, but rather is a wholly foreseeable result of TPV's focus on DigiCipher during its case-in-chief. With respect to Hitachi's general complaint, that TPV's invalidity case was predicated upon the DigiCipher reference, such does not in and of itself deprive Hitachi of a fair trial. On the contrary, TPV gambled its defense on one prior art reference and ultimately prevailed. Evidence is not unfairly prejudicial merely because it is adverse to the moving party. *Learmonth v. Sears, Roebuck & Co.*, 631 F.3d 724, 733 (5th Cir. 2011). On review of the trial record, the Court finds that the jury considered all of the evidence, judged the credibility of the witnesses, and rendered a verdict consistent with the weight of the evidence.

D. Conclusion

Based on the foregoing, the Court **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the DigiCipher Reference is not Prior Art, that the '310 and '375 Patents are Not Invalid, and for a New Trial With Respect to All Issues on the '310 and '375 Patents (Dkt. No. 361)

VII. HITACHI'S MOTION FOR JUDGMENT AS A MATTER OF LAW PURSUANT TO RULE 50(B) THAT THE '243 PATENT IS INFRINGED OR, ALTERNATIVELY, FOR A NEW TRIAL PURSUANT TO RULE 59(A) (DKT. NO. 362)

Hitachi moves this Court to enter a judgment as a matter of law that TPV infringes claims 4 and 5 of the '243 patent because TPV's expert witness, Dr. Reader, failed to apply the Court's claim construction on one contested claim element. Claims 4 and 5 of the '243 patent both depend upon independent claim 1. The disputed element in claim 1 is "a plurality of video processor sections, with respective video processor sections providing video processing according to a different video signal format of said plurality of different video signal formats." The term "video signal formats" was previously construed by the Court to mean "number of scan lines and whether the lines are progressive or interlaced." (*See* Markman Opinion, Dkt. No. 170.) The parties agreed that the term "video processor sections" would have its plain and ordinary meaning. (*Id.*) Hitachi now contends that Dr. Reader's testimony was incompatible with the Court's construction and cannot be reconciled with the language of the claims. The section of challenged testimony is reproduced as follows:

> A. …And the claim limitation says that each of those video processor sections provides video processing according to a different video signal format, okay?
>
> Q. (By Mr. Landis) Now, just to remind the jury, has the Court construed the term video signal format?
>
> A. Yes, it has.
>
> Q. How -- what's the construction that the Court has used?
>
> A. So video signal format has been construed by the Court to be the number of lines and whether the lines are progressive or interlaced.
>
> Q. So using that Court -- using the Court's construction, what does this claim language mean to you?
>
> A. Well, it tells me that -- that each of the video processor sections is going to process the signal according to the number of lines and whether the lines are interlaced or progressive.

(4/11/2013 AM Tr. 37:1-18.)

Hitachi argues that TPV avoided the plain and ordinary meaning of "video processing sections" and improperly limited it to a video processor section that must perform *both* scaling *and* deinterlacing. TPV responds that was not the case; Dr. Reader testified that to meet this claim limitation, a video processor section would have to "process the signal according to the number of lines and whether the lines are interlaced or progressive." (4/11/2013 AM Tr. 37:16-18.) According to TPV, Dr. Reader applied the construction given by the Court for "video signal formats" and, using that construction, Dr. Reader explained the plain and ordinary meaning of "processing according to" what that construction means to a person of ordinary skill in the art. TPV asserts that this is merely a case where Hitachi's expert, Dr. Harley Myler, performed the same analysis but reached a different conclusion (that the claim element would be satisfied by converting *either* the number of scan lines *or* the progressive/interlaced aspect of the signal). On review of the record, the Court agrees with TPV.

"[A]fter the court has defined [a] claim with whatever specific and precision is warranted by the language of the claim and the evidence bearing on the proper constructions, the task of determining whether the construed claim reads on the accused product is for the finder of fact." *PPG Indus. v. Guardian Indus. Corp.*, 156 F.3d 1351, 1355 (Fed. Cir. 1998) (citing *W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 842 F.2d 1275, 1280 (Fed. Cir. 1988)). The Court finds that Dr. Reader properly applied the Court's construction of "video signal format." For terms that are given their plain and ordinary meaning, the jury is free to apply an expert's description of the claims if it is consistent with the jury's understanding. *Haberman v. Gerber Products Co.*, 236 F. App'x 592, 600 (Fed. Cir. 2007). Drawing all reasonable inferences from the testimony in TPV's favor, the Court finds a reasonable jury could have reached a finding of no infringement of the '243 patent.

Contrary to Hitachi's assertion, this is certainly not a situation where Dr. Reader's opinion cannot be reconciled with either the language of the claims at issue or the evidence presented at trial. The jury, in its role as fact finder, properly evaluated the credibility of both experts and arrived at a verdict consistent with the evidence presented. The Court concludes that substantial evidence exists in the record to support the jury's finding that Hitachi failed to make a *prima facie* case of infringement of the '243 patent.

For the foregoing reasons, the Court **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the '243 Patent is Infringed or, Alternatively, for a New Trial Pursuant to Rule 59(a) (Dkt. No. 362).

VIII. CONCLUSION

For the reasons discussed, the Court: (1) **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the '310 and '375 Patents are Infringed or, Alternatively, for a New Trial Pursuant to Rule 59(a) (Dkt. No. 359); (2) **DENIES** Hitachi's Motion Pursuant to Rule 59 For a New Trial on All Issues Due to Submission of False Testimony and Improper Argument (Dkt. No. 360); (3) **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the DigiCipher Reference is not Prior Art, that the '310 and '375 Patents are Not Invalid, and for a New Trial With Respect to All Issues on the '310 and '375 Patents (Dkt. No. 361); and (4) **DENIES** Hitachi's Motion for Judgment as a Matter of Law Pursuant to Rule 50(b) that the '243 Patent is Infringed or, Alternatively, for a New Trial Pursuant to Rule 59(a) (Dkt. No. 362)

So ORDERED and SIGNED this 18th day of September, 2013.

RODNEY GILSTRAP
UNITED STATES DISTRICT JUDGE

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

HITACHI CONSUMER ELECTRONICS CO. LTD., et al., *Plaintiffs,*	§	
	§	**CAUSE NO. 2:10-CV-260-JRG**
V.	§	
TOP VICTORY ELECTRONICS (TAIWAN) CO LTD, et al., *Defendants.*	§	

FINAL JUDGMENT

Before the Court is Defendants Top Victory Electronics (Taiwan) Co. Ltd., TPV International (USA), Inc., Envision Peripherals, Inc., Top Victory Electronics (Fujian) Co., Ltd., TPV Electronics (Fujian) Co. Ltd., and TPV Technology Ltd.'s (collectively, "Defendants" or "TPV") Motion for Entry of Judgment and Taxable Costs (Dkt. No. 354). A jury trial commenced in this case on April 8, 2013, and the jury reached and returned its unanimous verdict on April 12, 2013. (Dkt. No. 335.) Pursuant to Rule 58 of the Federal Rules of Civil Procedure and in accordance with the jury's verdict and the entirety of the record available to the Court, the Court **ORDERS AND ENTERS JUDGMENT** as follows:

1. TPV does not infringe Claim 7 of U.S. Patent No. 7,286,310.

2. TPV does not infringe Claims 26 or 30 of U.S. Patent No. 8,009,375.

3. TPV does not infringe Claims 15 or 16 of U.S. Patent No. 5,502,497.

4. TPV does not infringe Claims 4 or 5 of U.S. Patent No. 6,549,243.

5. Claim 7 of U.S. Patent No. 7,286,310 is invalid.

6. Claims 26 and 30 of U.S. Patent No. 8,009,375 are invalid.

Pursuant to Rule 54(d) of the Federal Rules of Civil Procedure and 28 U.S.C. § 1920, the Court finds that TPV is the prevailing party in this matter and is entitled to costs consistent therewith. All pending motions are hereby **DENIED**.

So ORDERED and SIGNED this 19th day of September, 2013.

RODNEY GILSTRAP
UNITED STATES DISTRICT JUDGE

(12) **United States Patent**
Arai et al.

(10) **Patent No.: US 7,286,310 B2**
(45) **Date of Patent: *Oct. 23, 2007**

(54) **APPARATUS FOR RECEIVING COMPRESSED DIGITAL INFORMATION**

(75) Inventors: **Hideo Arai**, Chigasaki (JP); **Hitoaki Owashi**, Yokohama (JP); **Kyoichi Hosokawa**, Yokohama (JP); **Keizo Nishimura**, Yokosuka (JP); **Yoshizumi Watatani**, Fujisawa (JP); **Akira Shibata**, Katsuta (JP)

(73) Assignee: **Hitachi, Ltd.**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/495,464**

(22) Filed: **Jul. 31, 2006**

(65) **Prior Publication Data**

US 2006/0269254 A1 Nov. 30, 2006

Related U.S. Application Data

(60) Continuation of application No. 11/305,229, filed on Dec. 19, 2005, now Pat. No. 7,027,240, which is a continuation of application No. 10/404,452, filed on Apr. 2, 2003, now Pat. No. 7,012,769, which is a continuation of application No. 10/277,830, filed on Oct. 23, 2002, now Pat. No. 6,590,726, which is a continuation of application No. 09/809,047, filed on

(Continued)

(30) **Foreign Application Priority Data**

Jul. 6, 1990 (JP) 2002-177406
Jul. 20, 1990 (JP) 2002-190655
Sep. 21, 1990 (JP) 2002-250199

(51) **Int. Cl.**
G11B 5/00 (2006.01)

(52) **U.S. Cl.** **360/8**; 386/109
(58) **Field of Classification Search** ..... None
See application file for complete search history.

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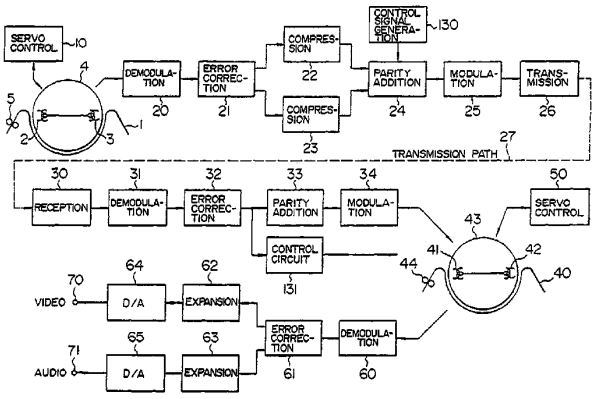
Primary Examiner—Tan Dinh
(74) *Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus, LLP.

(57) **ABSTRACT**

An apparatus for receiving digital information including a receiver which receives the digital information that has digital video information bit-compressed by a first compression system, digital audio information bit-compressed by a second compression system, and error-detection information added to both the digital video information and the digital audio information. There is also provided a demodulator which demodulates the digital information received by the receiver, an error detector which detects an error of digital information demodulated by the demodulator by use of the error-detection information, a first expander which bit-expands video information among the digital information error detected by the error detector corresponding system, and a second expander which bit-expands audio information among the digital information error detected by the error detector corresponding to the second compression system.

7 Claims, 18 Drawing Sheets



RELATED U.S. APPLICATION DATA

Mar. 16, 2001, now Pat. No. 6,498,691, which is a continuation of application No. 09/654,962, filed on Sep. 5, 2000, now Pat. No. 6,324,025, which is a continuation of application No. 09/567,005, filed on May 9, 2000, now Pat. No. 6,278,564, which is a continuation of application No. 09/326,595, filed on Jun. 7, 1999, now Pat. No. 6,069,757, which is a continuation of application No. 09/188,303, filed on Nov. 10, 1998, now Pat. No. 6,002,536, which is a continuation of application No. 08/917,176, filed on Aug. 25, 1997, now Pat. No. 5,862,004, which is a continuation of application No. 08/620,879, filed on Mar. 22, 1996, now Pat. No. 5,699,203, and a continuation of application No. 08/620,880, filed on Mar. 22, 1996, now Pat. No. 5,673,154, which is a continuation of application No. 08/457,597, filed on Jun. 1, 1995, now Pat. No. 5,530,598, which is a continuation of application No. 08/457,486, filed on Jun. 1, 1995, now Pat. No. 5,517,368, which is a continuation of application No. 08/238,528, filed on May 5, 1994, now Pat. No. 5,671,095, which is a division of application No. 07/727,059, filed on Jul. 8, 1991, now Pat. No. 5,337,199.

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JP	64-082711	3/1989
JP	64-89878	4/1989
JP	1-114176	5/1989
JP	1-125186	5/1989
JP	1-276470	11/1989
JP	2-14619	1/1990
JP	2-62856	5/1990
JP	90655/90	5/1999
JP	105643/97	6/1999
JP	163728/97	6/1999

* cited by examiner

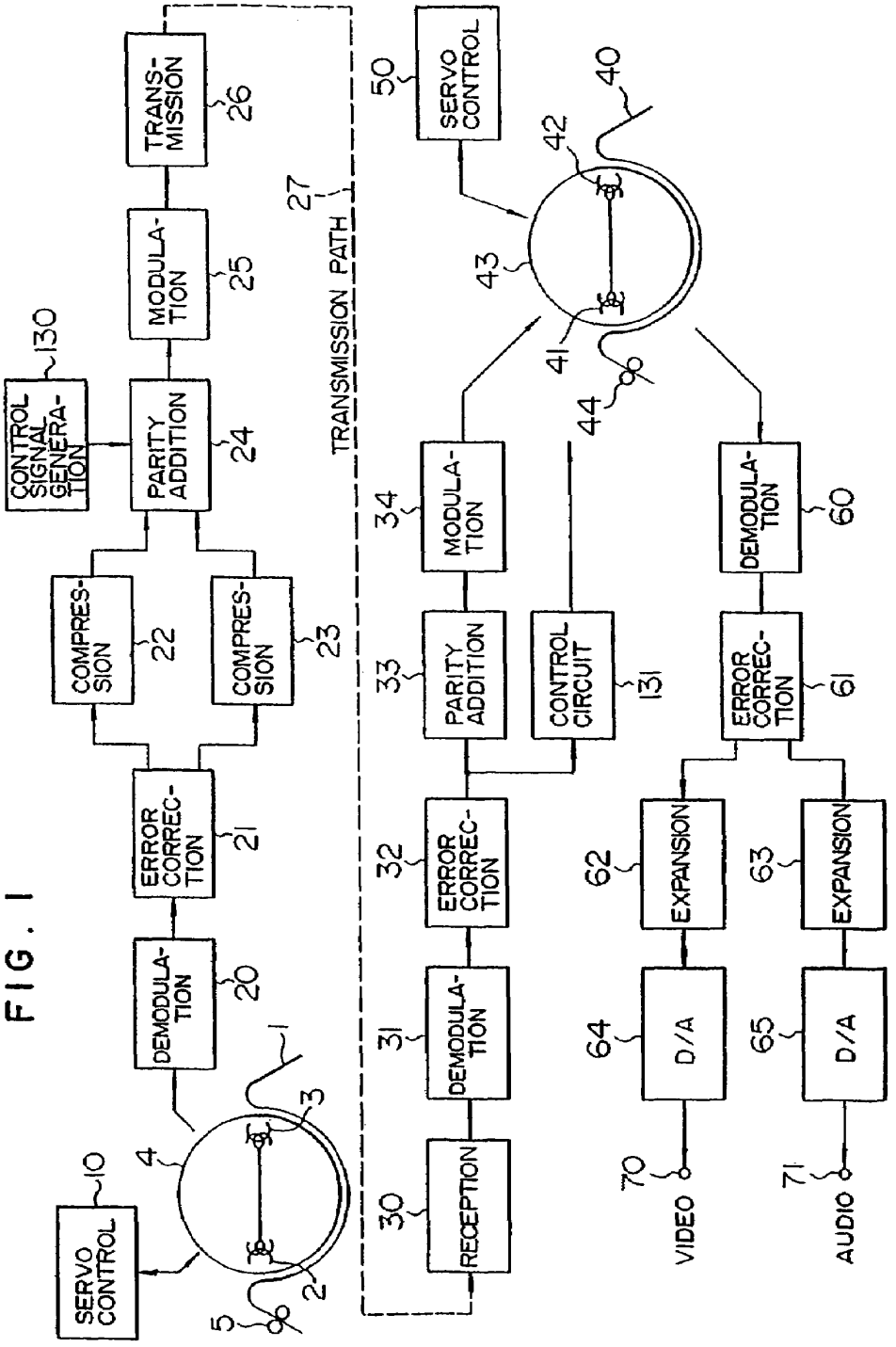

SERVO CONTROL
10
1
2
3
4
5
6
7
8
DEMODULATION
20
ERROR CORRECTION
21
COMPRESSION
22
COMPRESSION
23
PARITY ADDITION
24
MODULATION
25
TRANSMISSION
26
27
TRANSMISSION PATH
CONTROL SIGNAL GENERATION
130
RECEPTION
30
DEMODULATION
31
ERROR CORRECTION
32
PARITY ADDITION
33
MODULATION
34
CONTROL CIRCUIT
131
SERVO CONTROL
50
40
41
42
43
44
DEMODULATION
60
ERROR CORRECTION
61
EXPANSION
62
EXPANSION
63
D/A
64
D/A
65
VIDEO
70
AUDIO
71

FIG. 1

FIG. 2

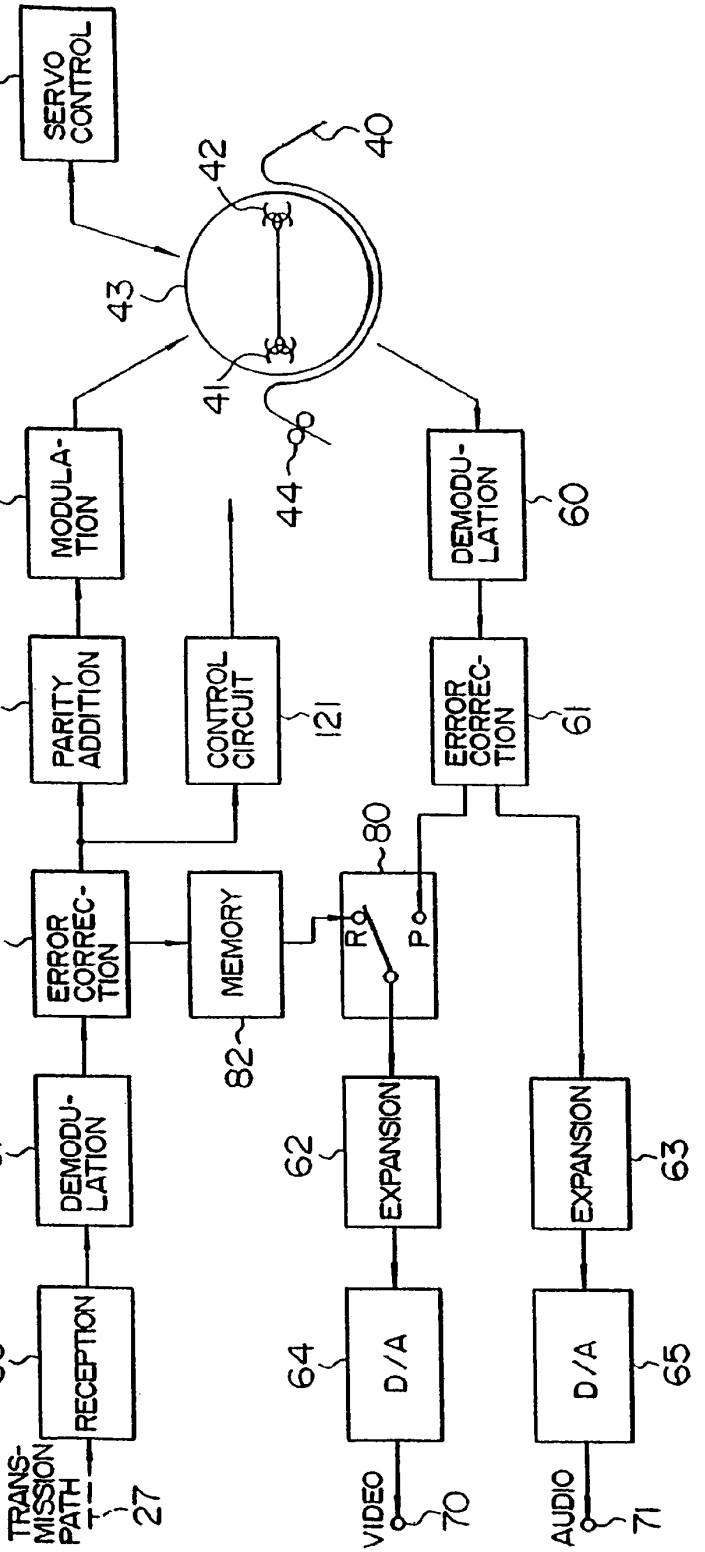

50
SERVO CONTROL
42
40
43
41
44
34
MODULA-TION
DEMODU-LATION
60
33
PARITY ADDITION
CONTROL CIRCUIT
121
ERROR CORREC-TION
61
80
81
ERROR CORREC-TION
MEMORY
R
P
82
31
DEMODU-LATION
62
EXPANSION
63
30
RECEPTION
64
D/A
65
TRANS-MISSION PATH
27
VIDEO
70
AUDIO
71

FIG. 3

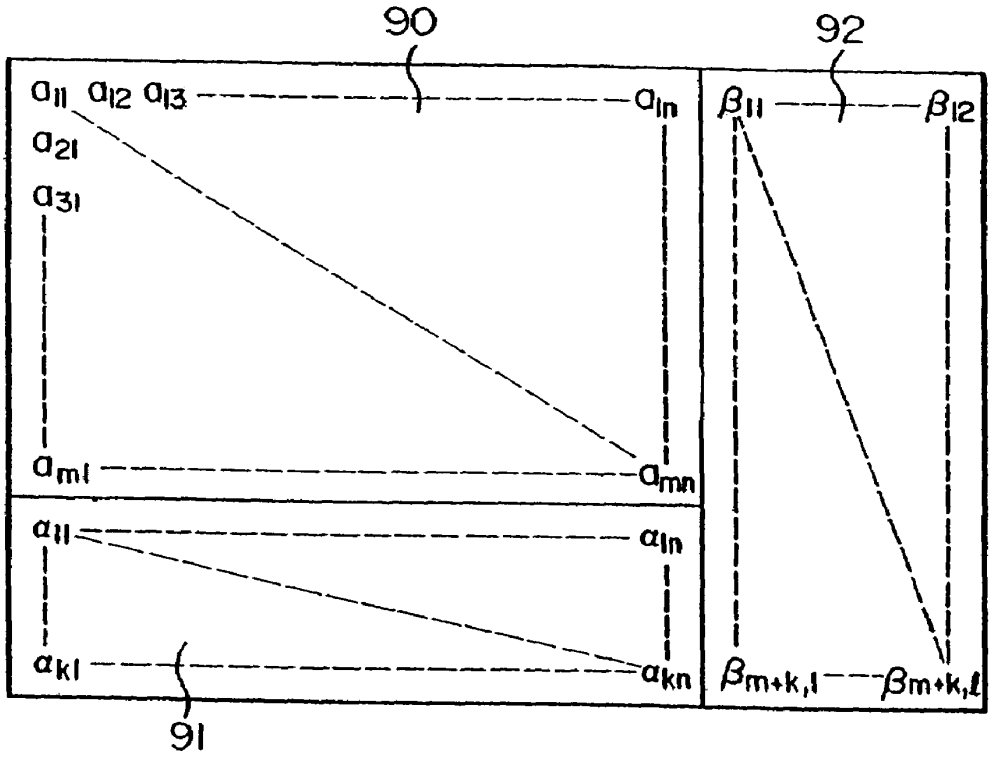
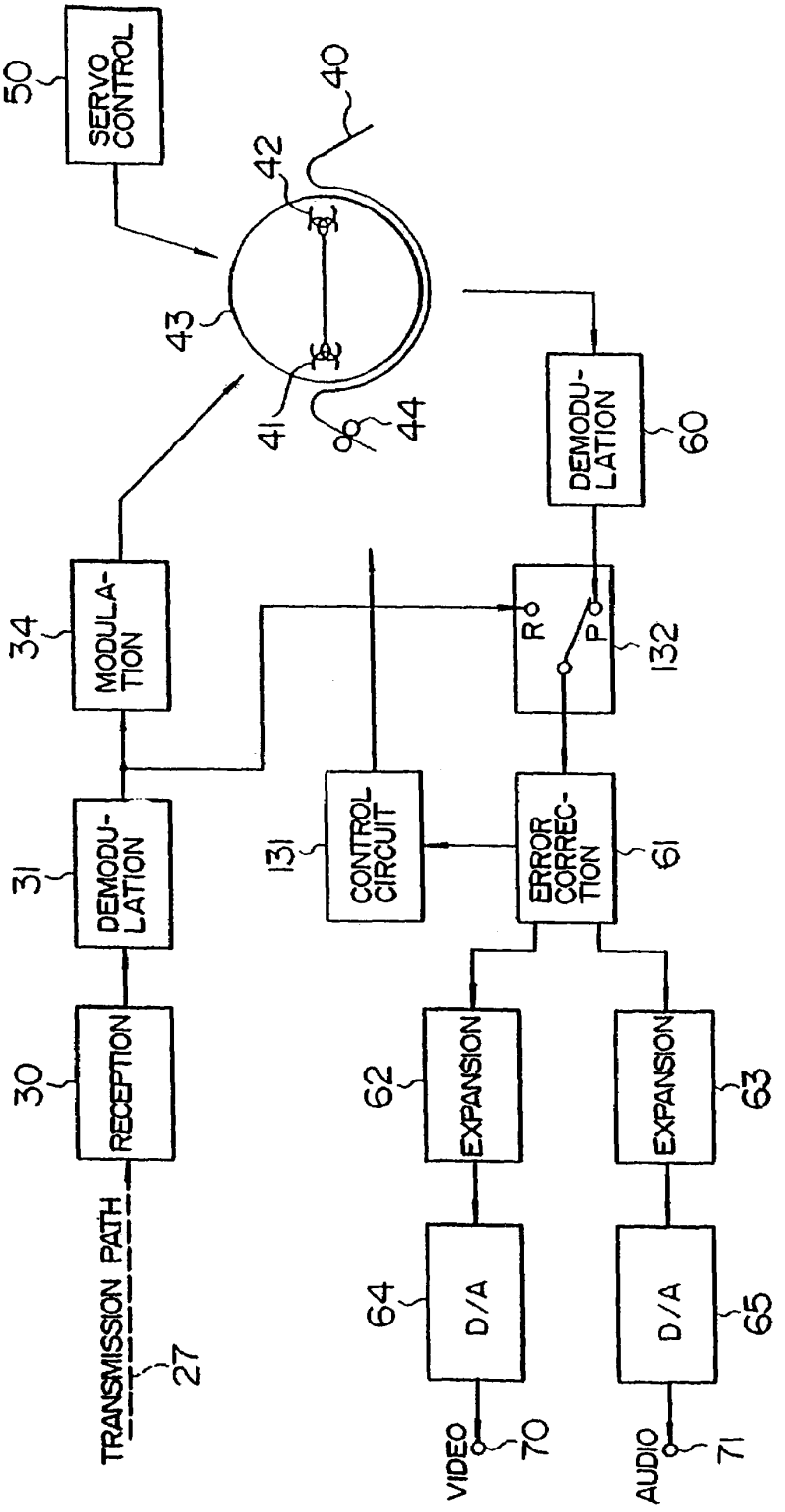

90
92
a_{11} a_{12} a_{13}
a_{1n}
a_{21}
a_{31}
a_{m1}
a_{mn}
β_{11}
β_{12}
a_{11}
a_{1n}
a_{k1}
a_{kn}
$\beta_{m+k,1}$
$\beta_{m+k,l}$
91

FIG. 4


50
SERVO CONTROL
40
42
43
41
44
DEMODU-LATION
60
34
MODULA-TION
R
P
132
31
DEMODU-LATION
131
CONTROL CIRCUIT
ERROR CORREC-TION
61
30
RECEPTION
62
EXPANSION
63
EXPANSION
TRANSMISSION PATH
27
64
D/A
65
D/A
VIDEO
70
AUDIO
71

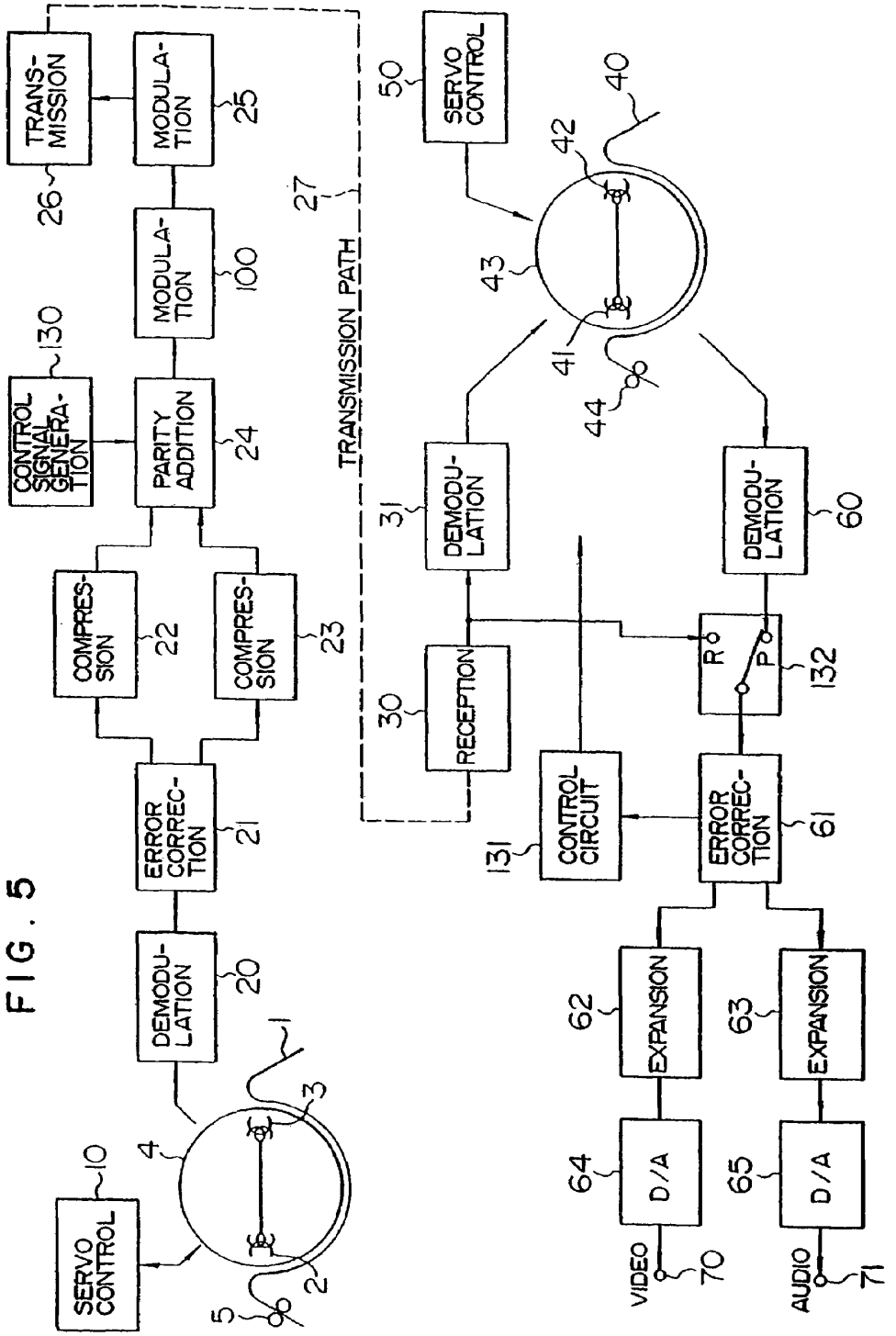

TRANS-MISSION
MODULA-TION
25
26
27
TRANSMISSION PATH
50
SERVO CONTROL
40
42
43
41
44
MODULA-TION
100
130
CONTROL SIGNAL GENERA-TION
PARITY ADDITION
24
DEMODU-LATION
31
DEMODU-LATION
60
COMPRES-SION
22
COMPRES-SION
23
R
P
132
30
RECEPTION
CONTROL CIRCUIT
131
ERROR CORREC-TION
21
ERROR CORREC-TION
61
DEMODU-LATION
20
1
3
4
2
5
10
SERVO CONTROL
62
EXPANSION
63
EXPANSION
64
D/A
65
D/A
VIDEO
70
AUDIO
71

FIG. 5

FIG. 6

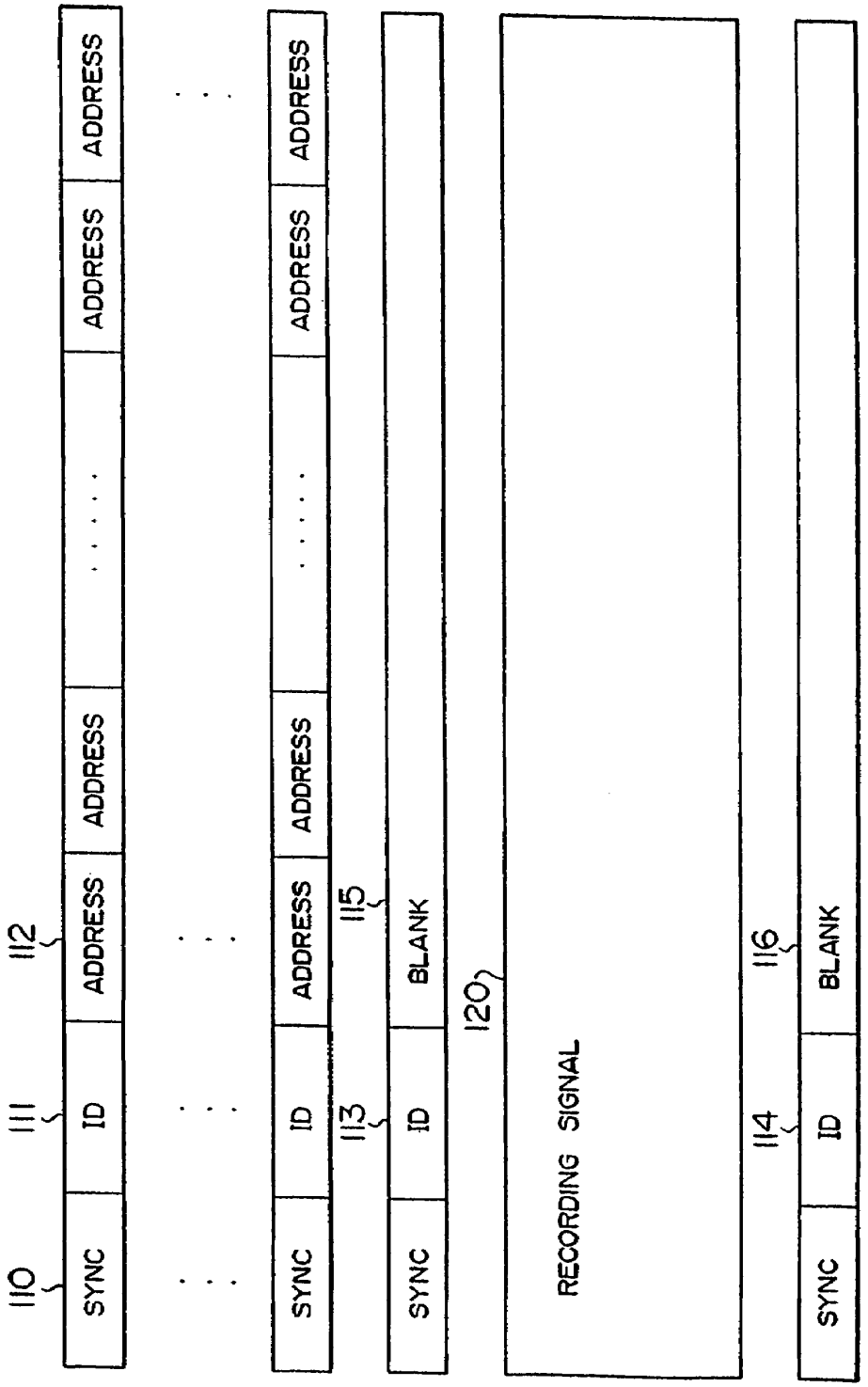

110
111
112
113
114
115
116
120
SYNC
ID
ADDRESS
BLANK
RECORDING SIGNAL

FIG. 7

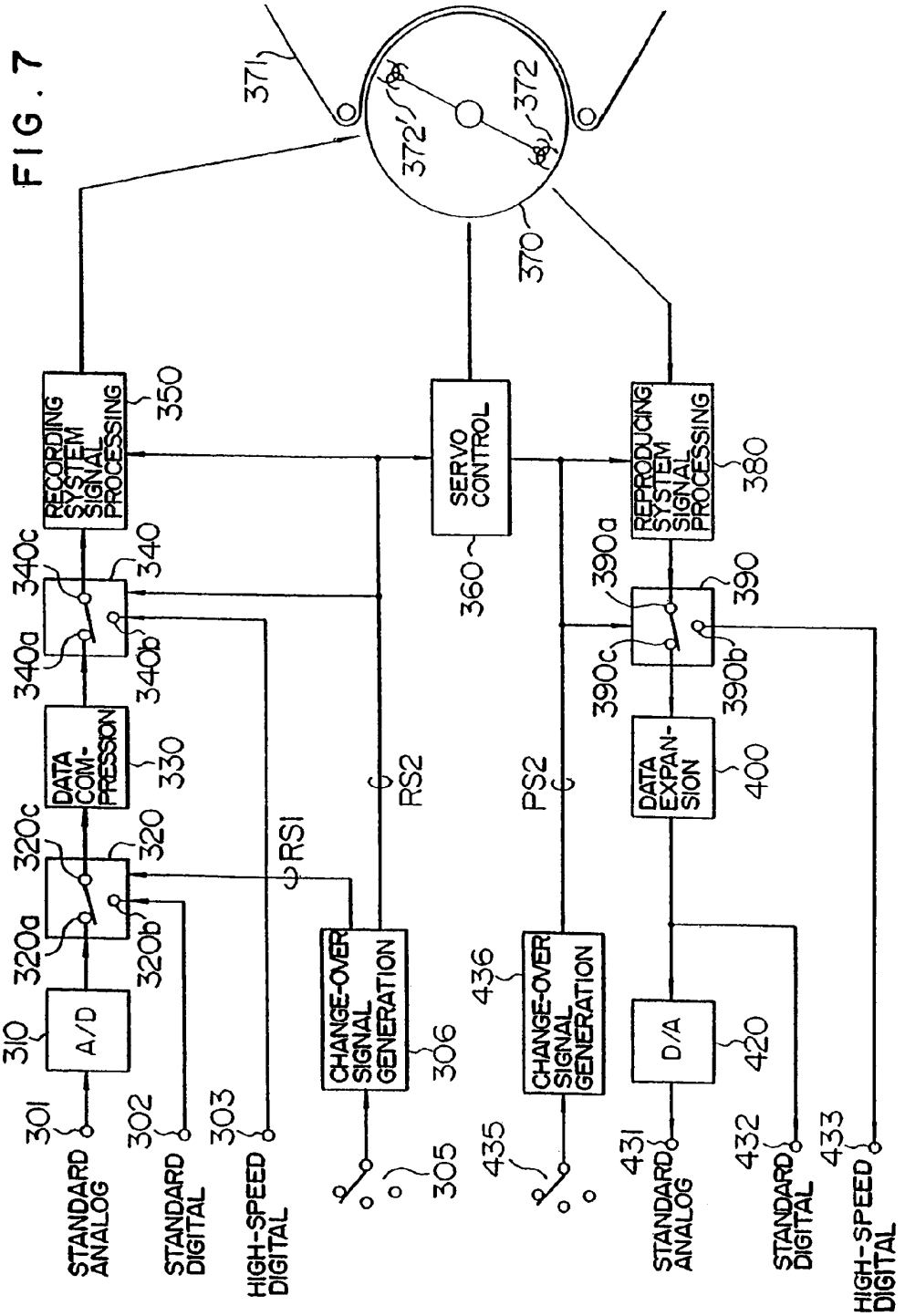

371
372
372'
370
RECORDING SYSTEM SIGNAL PROCESSING
350
SERVO CONTROL
360
REPRODUCING SYSTEM SIGNAL PROCESSING
380
340c
340
340a
340b
390a
390
390c
390b
DATA COM-PRESSION
330
DATA EXPAN-SION
400
320c
320
320a
320b
RS1
RS2
PS2
A/D
310
CHANGE-OVER SIGNAL GENERATION
306
436
CHANGE-OVER SIGNAL GENERATION
D/A
420
301
302
303
305
435
431
432
433
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL

FIG. 8

ITEM / INPUT		FIELD FREQUENCY	TRANSMISSION RATE	DATA COMPRESSION	TIME-BASE COMPRESSION
STANDARD SPEED	ANALOG	59.94 Hz	(AFTER A/D) 114 Mbps	ABSENCE	ABSENCE
	DIGITAL		114 Mbps		
HIGH SPEED	DIGITAL	59.94 Hz	100 Mbps	PRESENCE 1/11.4	PRESENCE 1/10

FIG. 9

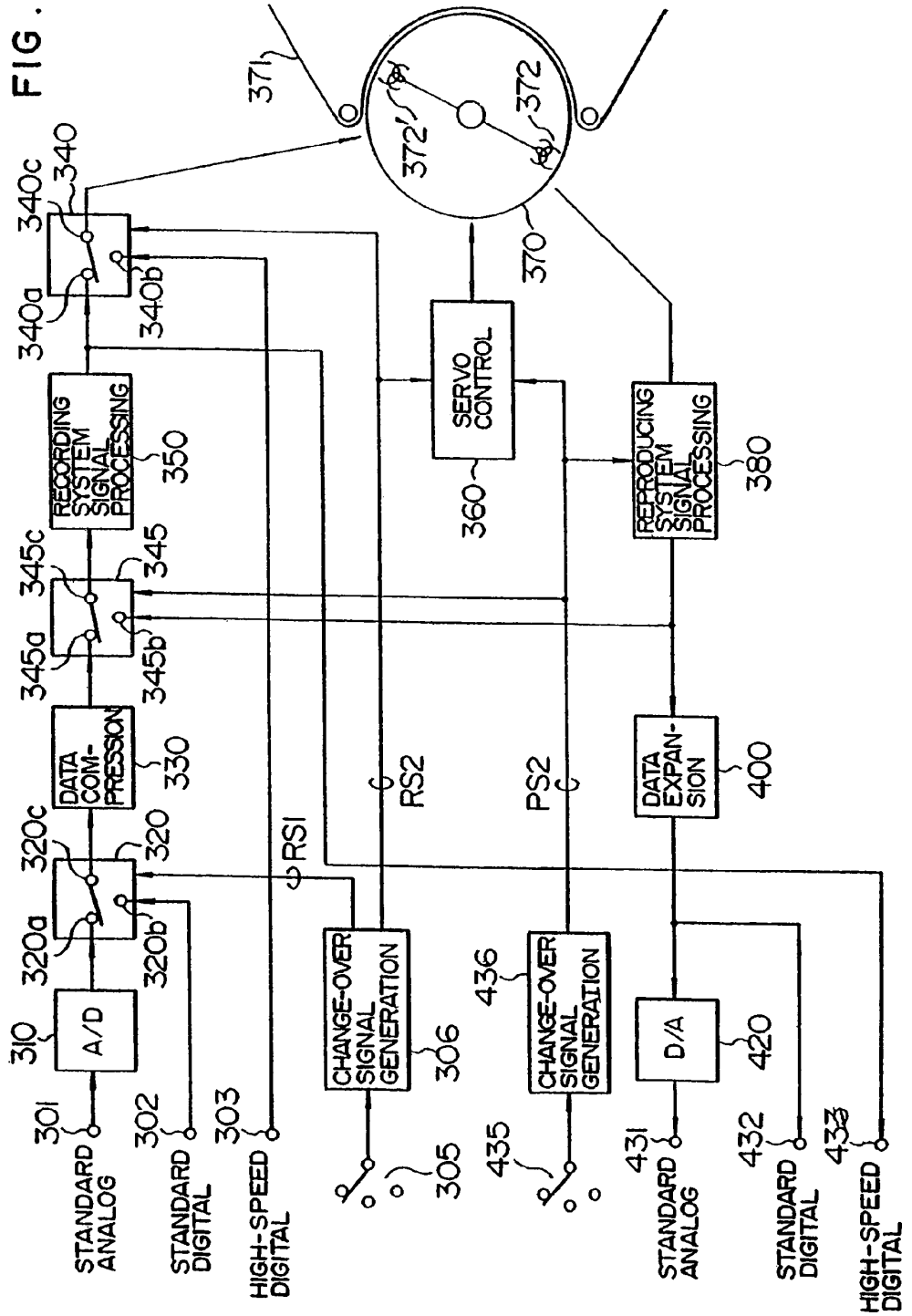

371
372
372'
370
340
340c
340a
340b
SERVO CONTROL
360
RECORDING SYSTEM SIGNAL PROCESSING
350
REPRODUCING SYSTEM SIGNAL PROCESSING
380
345
345c
345a
345b
DATA COM-PRESSION
330
DATA EXPAN-SION
400
320
320c
320a
320b
RS1
RS2
PS2
310
A/D
CHANGE-OVER SIGNAL GENERATION
306
436
CHANGE-OVER SIGNAL GENERATION
D/A
420
301
302
303
305
435
431
432
433
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL

FIG. 10

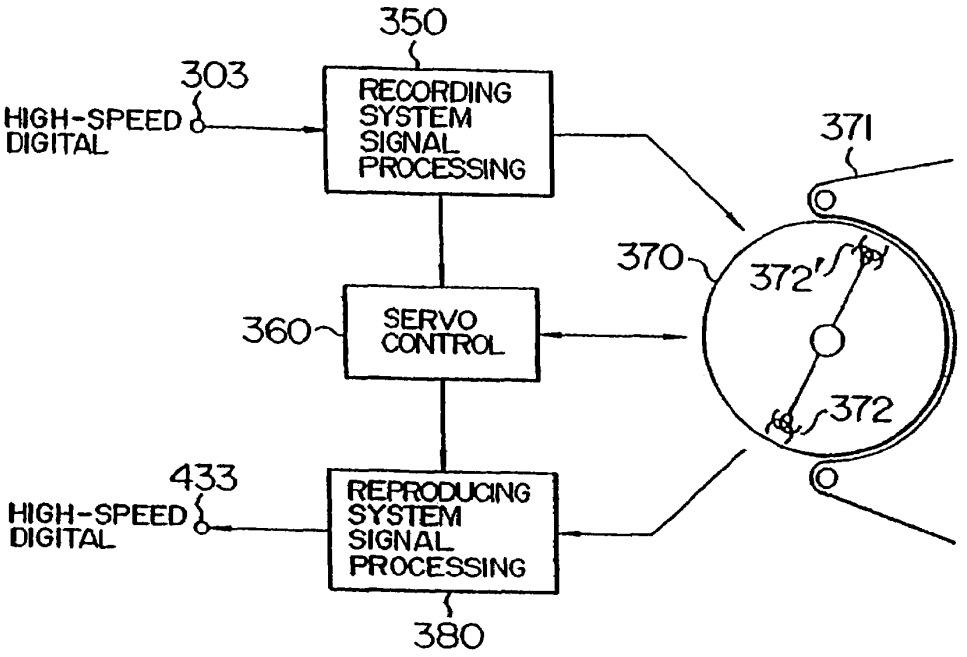

350
303
HIGH-SPEED DIGITAL
RECORDING SYSTEM SIGNAL PROCESSING
371
370
372'
372
360
SERVO CONTROL
433
HIGH-SPEED DIGITAL
REPRODUCING SYSTEM SIGNAL PROCESSING
380

FIG. 11

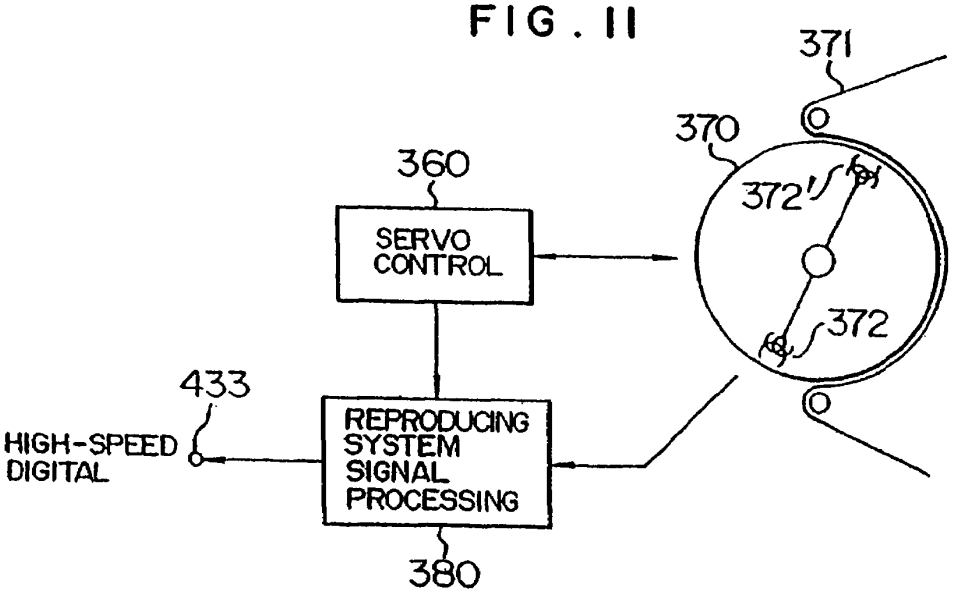

371
370
372'
372
360
SERVO CONTROL
433
HIGH-SPEED DIGITAL
REPRODUCING SYSTEM SIGNAL PROCESSING
380

FIG. 12

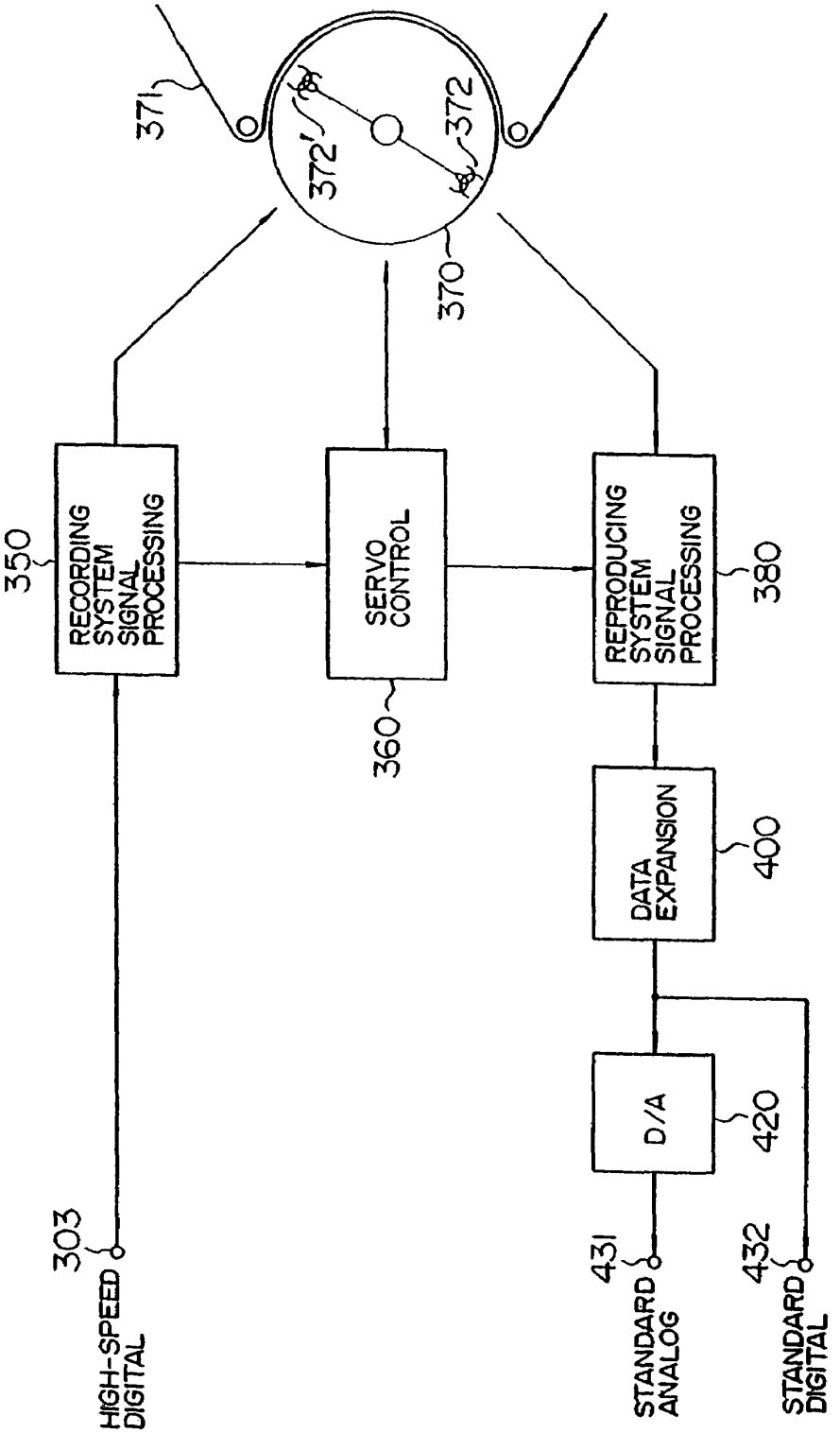

371
372'
372
370
350
RECORDING SYSTEM SIGNAL PROCESSING
SERVO CONTROL
360
REPRODUCING SYSTEM SIGNAL PROCESSING
380
DATA EXPANSION
400
D/A
420
303
HIGH-SPEED DIGITAL
431
STANDARD ANALOG
432
STANDARD DIGITAL

FIG. 13

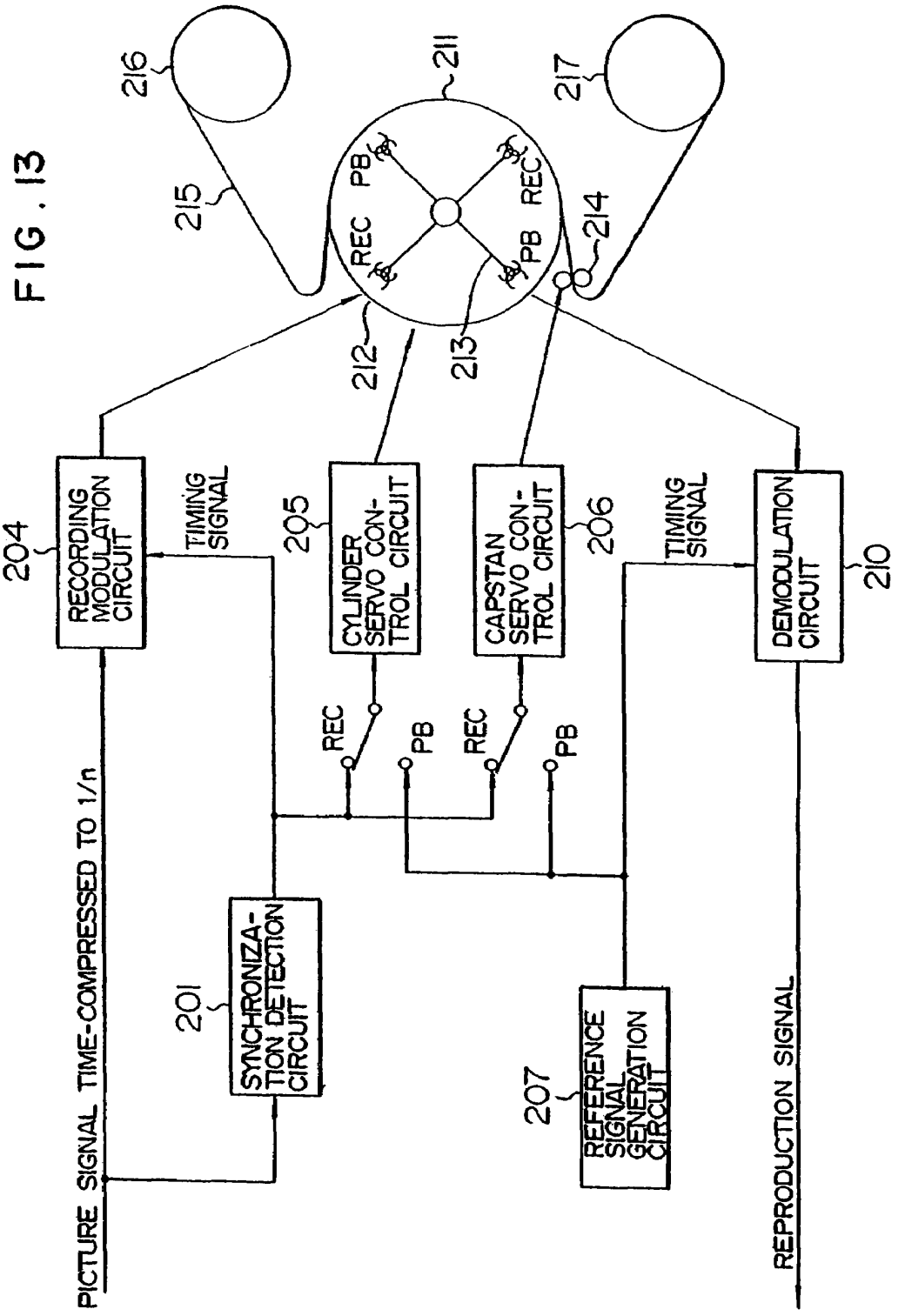

216
211
217
215
214
212
213
REC
PB
PB
REC
204
RECORDING MODULATION CIRCUIT
TIMING SIGNAL
205
CYLINDER SERVO CONTROL CIRCUIT
CAPSTAN SERVO CONTROL CIRCUIT
206
TIMING SIGNAL
DEMODULATION CIRCUIT
210
REC
PB
REC
PB
PICTURE SIGNAL TIME-COMPRESSED TO 1/n
201
SYNCHRONIZATION DETECTION CIRCUIT
207
REFERENCE SIGNAL GENERATION CIRCUIT
REPRODUCTION SIGNAL

FIG. 14

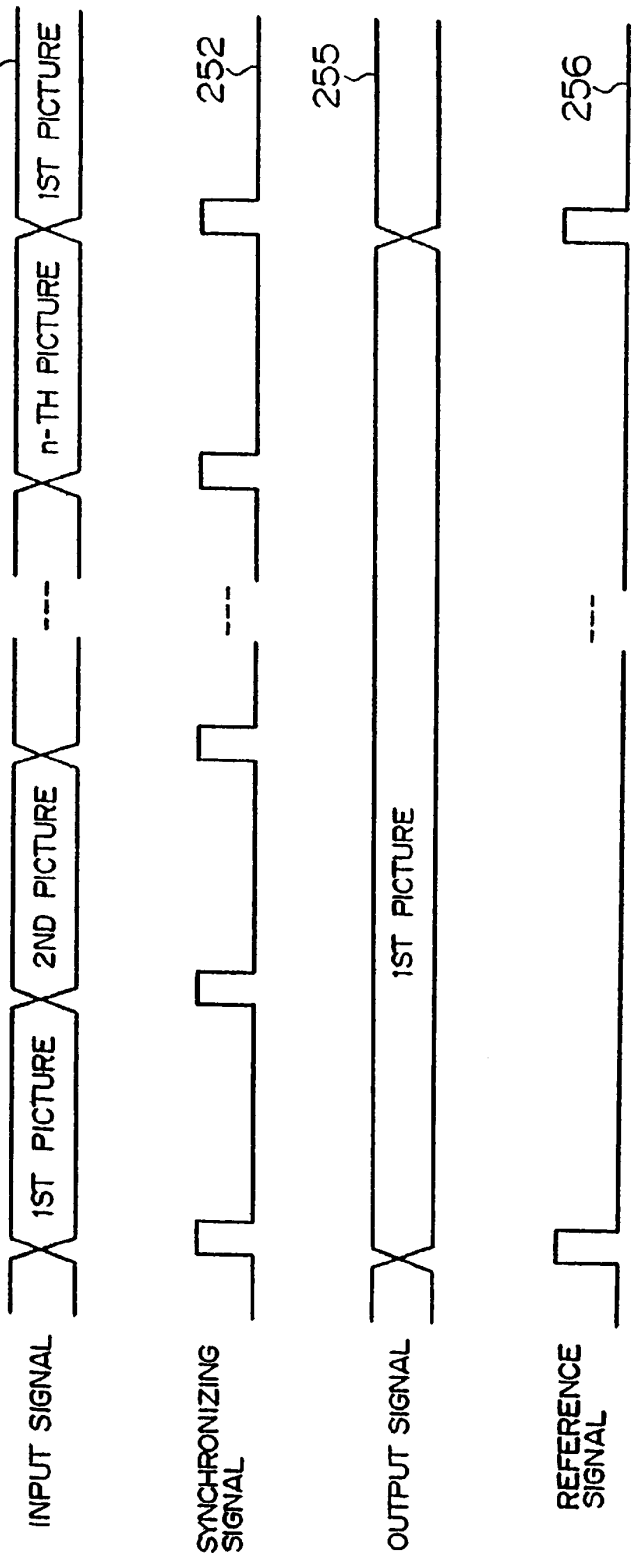

251
252
255
256
1ST PICTURE
2ND PICTURE
n-TH PICTURE
1ST PICTURE
INPUT SIGNAL
SYNCHRONIZING SIGNAL
OUTPUT SIGNAL
REFERENCE SIGNAL

FIG. 15

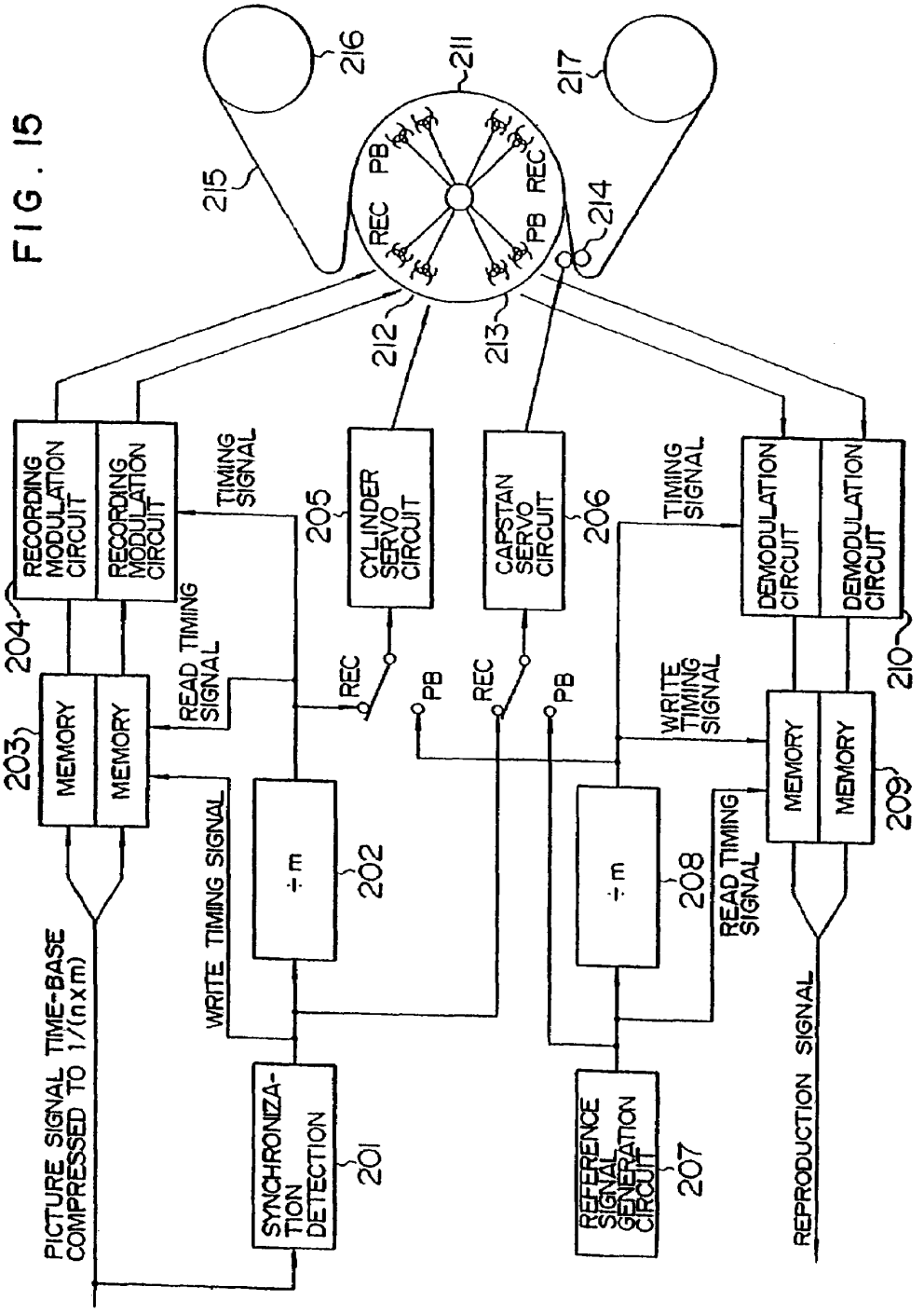

216
211
217
215
214
212
213
REC
PB
PB
REC
RECORDING MODULATION CIRCUIT
RECORDING MODULATION CIRCUIT
TIMING SIGNAL
205
CYLINDER SERVO CIRCUIT
CAPSTAN SERVO CIRCUIT
206
TIMING SIGNAL
DEMODULATION CIRCUIT
DEMODULATION CIRCUIT
204
READ TIMING SIGNAL
REC
PB
REC
PB
WRITE TIMING SIGNAL
210
203
MEMORY
MEMORY
MEMORY
MEMORY
209
WRITE TIMING SIGNAL
÷m
202
÷m
208
READ TIMING SIGNAL
PICTURE SIGNAL TIME-BASE COMPRESSED TO 1/(n×m)
SYNCHRONIZATION DETECTION
201
REFERENCE SIGNAL GENERATION CIRCUIT
207
REPRODUCTION SIGNAL

FIG. 16

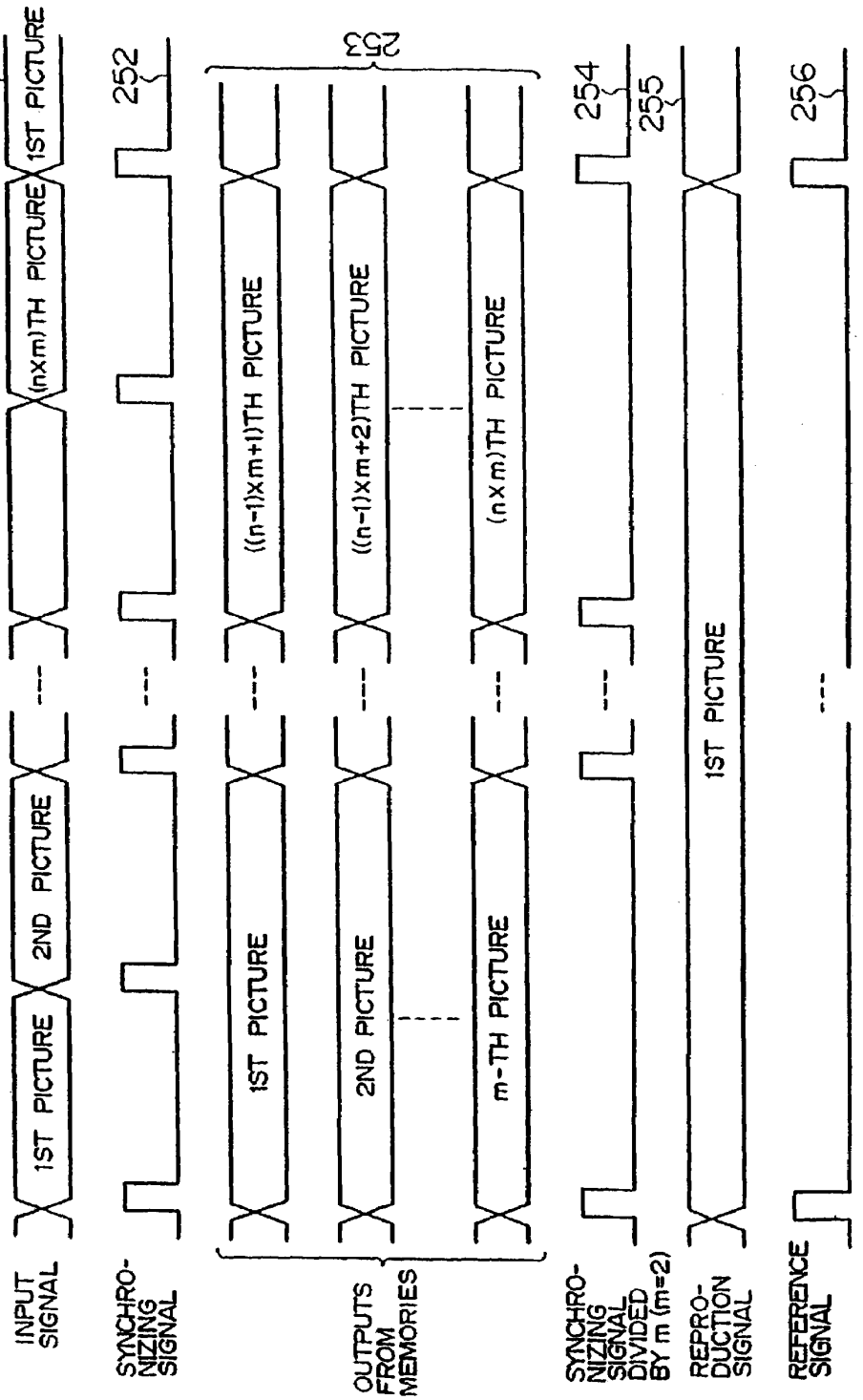
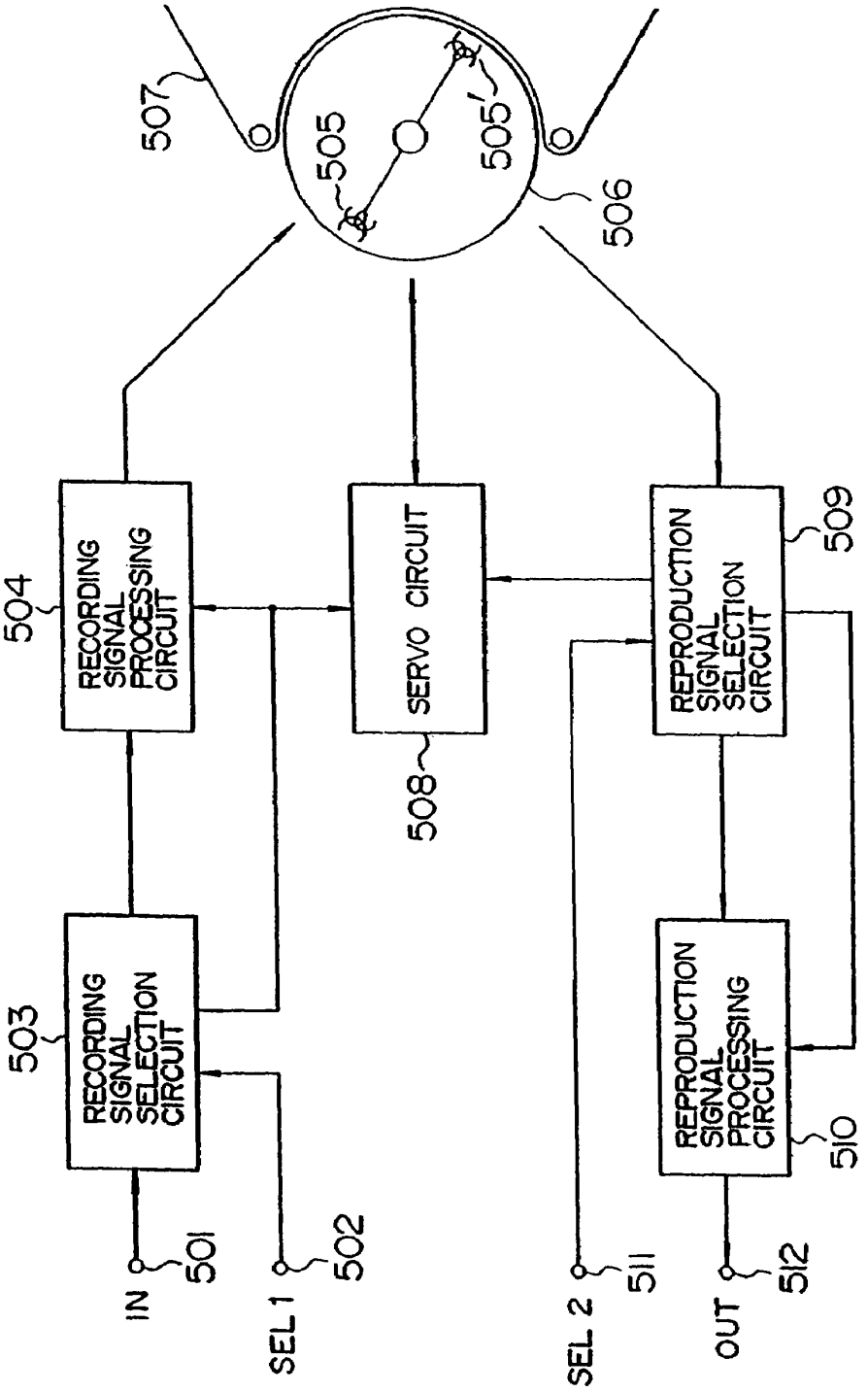

251
252
253
254
255
256
1ST PICTURE
2ND PICTURE
(n×m)TH PICTURE
((n-1)×m+1)TH PICTURE
((n-1)×m+2)TH PICTURE
m-TH PICTURE
INPUT SIGNAL
SYNCHRONIZING SIGNAL
OUTPUTS FROM MEMORIES
SYNCHRONIZING SIGNAL DIVIDED BY m (m=2)
REPRODUCTION SIGNAL
REFERENCE SIGNAL

FIG. 17

SYSTEM	MODE		TAPE SPEED (RATIO TO STANDARD SPEED)		CYLINDER ROTATION SPEED (rpm)		NUMBER OF HEAD PAIRS		CYLINDER DIAMETER (mmφ)	CYLINDER CONTACT ANGLE (deg)	NUMBER OF TRACKS REQUIRED FOR ONE PICTURE	REMARKS
	REC	PB	REC	PB	REC	PB	REC	PB				
VHS (NTSC)	NORMAL SPEED	NORMAL SPEED	1	1	1800	1800	1	1	62	180	1	
D2 (NTSC)	NORMAL SPEED	NORMAL SPEED	1	1	5400	5400	2	2	96	180	6	
EXAMPLE ①	HIGH SPEED	NORMAL SPEED	10	1	9000	900	1	1	120	180	1/2	
	HIGH SPEED	HIGH SPEED	10	10	9000	9000						
	NORMAL SPEED	HIGH SPEED	1	10	900	9000						
EXAMPLE ②	HIGH SPEED	NORMAL SPEED	10	1	9000	900	1	1	90	270	1/2	
	HIGH SPEED	HIGH SPEED	10	10	9000	9000						
	NORMAL SPEED	HIGH SPEED	1	10	900	9000						
EXAMPLE ③	HIGH SPEED	NORMAL SPEED	10	1	18000	1800	1	1	60	180	1	
	HIGH SPEED	HIGH SPEED	10	10	18000	18000						
	NORMAL SPEED	HIGH SPEED	1	10	1800	18000						
EXAMPLE ④	HIGH SPEED	NORMAL SPEED	10	1	9000	900	2	2	60	180	1	
	HIGH SPEED	NORMAL SPEED	10	10	9000	9000						
	NORMAL SPEED	HIGH SPEED	1	10	900	9000						
EXAMPLE ⑤	HIGH SPEED	NORMAL SPEED	10	1	9000	1800	2	1	60	180	1	MOVABLE HEADS ARE REQUIRED
	HIGH SPEED	HIGH SPEED	10	10	9000	9000	2	2				
	NORMAL SPEED	HIGH SPEED	1	10	1800	9000	1	2				

FIG. 18


507
505
505'
506
RECORDING SIGNAL PROCESSING CIRCUIT
504
SERVO CIRCUIT
508
REPRODUCTION SIGNAL SELECTION CIRCUIT
509
RECORDING SIGNAL SELECTION CIRCUIT
503
REPRODUCTION SIGNAL PROCESSING CIRCUIT
510
IN
501
SEL 1
502
SEL 2
511
OUT
512

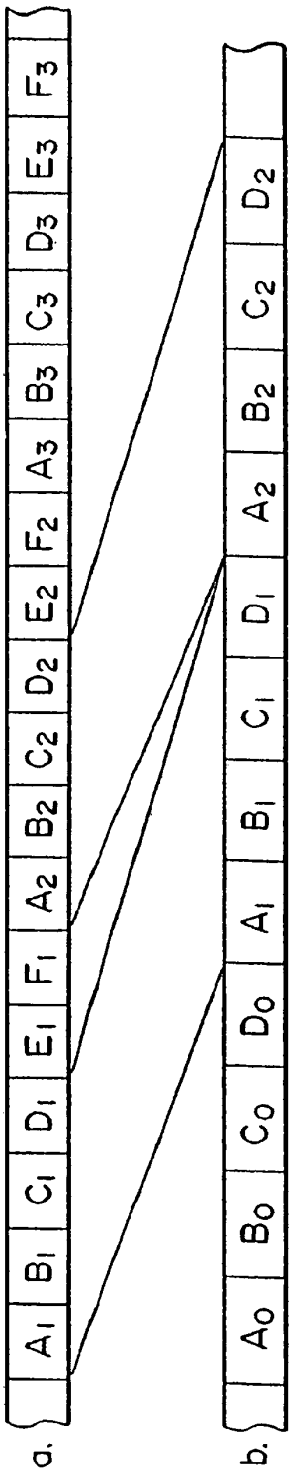

a.
b.
A1 B1 C1 D1 E1 F1 A2 B2 C2 D2 E2 F2 A3 B3 C3 D3 E3 F3
A0 B0 C0 D0 A1 B1 C1 D1 A2 B2 C2 D2

FIG. 19

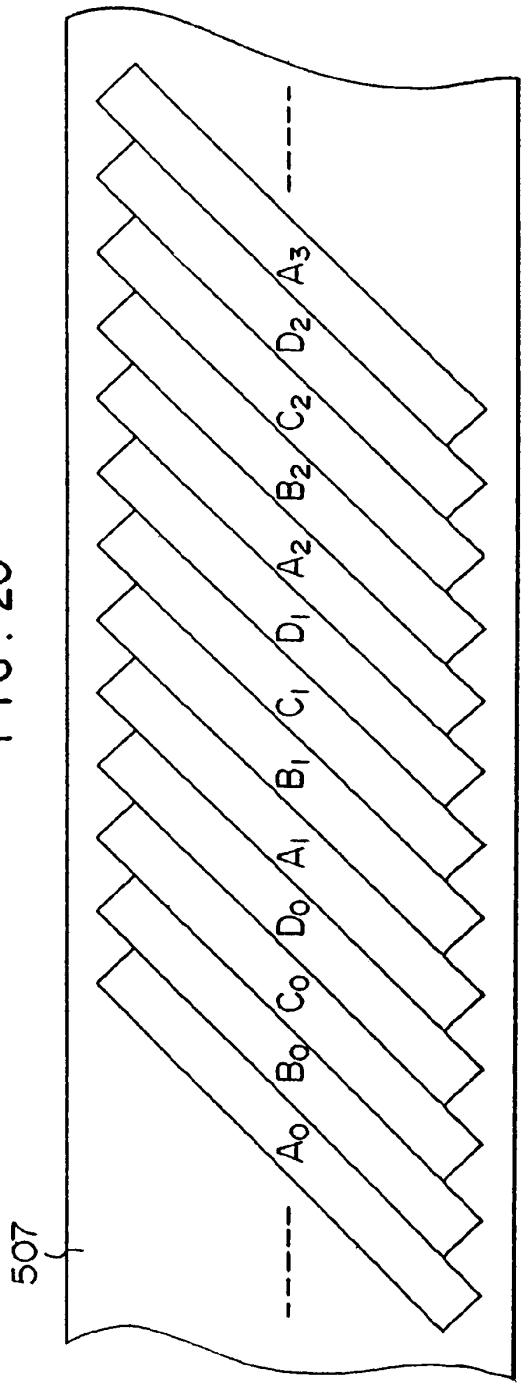

507
A0 B0 C0 D0 A1 B1 C1 D1 A2 B2 C2 D2 A3

FIG. 20

APPARATUS FOR RECEIVING COMPRESSED DIGITAL INFORMATION

CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation of U.S. application Ser. No. 11/305,229, filed Dec. 19, 2005, now U.S. Pat. No. 7,027,240, which is a continuation of U.S. application Ser. No. 10/404,452, filed Apr. 2, 2003, now U.S. Pat. No. 7,012,769, which is a continuation application of U.S. application Ser. No. 10/277,830, filed Oct. 23, 2002, now U.S. Pat. No. 6,590,726, which is a continuation of U.S. Ser. No. 09/809,047, filed Mar. 16, 2001, now U.S. Pat. No. 6,498,691, which is a continuation application of U.S. application Ser. No. 09/654,962, filed Sep. 5, 2000, now U.S. Pat. No. 6,324,025, which is a continuation of U.S. Ser. No. 09/567,005, filed May 9, 2000, now U.S. Pat. No. 6,278,564, which is a continuation application of U.S. Ser. No. 09/326,595, filed Jun. 7,1999, now U.S. Pat. No. 6,069,757, which is a continuation of U.S. application Ser. No. 09/188,303, filed Nov. 10, 1998, now U.S. Pat. No. 6,002,536, which is a continuation of U.S. application Ser. No. 08/917,176, filed Aug. 25, 1997, now U.S. Pat. No. 5,862,004, which is a continuation of U.S. application Ser. No. 08/620,879, filed Mar. 22, 1996, now U.S. Pat. No. 5,699,203, and copending with U.S. application Ser. No. 08/620,880, filed Mar. 22, 1996, now U.S. Pat. No. 5,673,154, which are continuations of U.S. application Ser. No. 08/457,597, filed Jun. 1, 1995, now U.S. Pat. No. 5,530,598, which is a continuation of U.S. application Ser. No. 08/457,486, filed Jun. 1, 1995, now U.S. Pat. No. 5,517,368, which is a continuation of U.S. application Ser. No. 08/238,528, filed May 5,1994, now U.S. Pat. No. 5,671 ,095, which is a divisional of U.S. application Ser. No. 07/727,059, filed Jul. 8, 1991, now U.S. Pat. No. 5,337,199, the subject matter of which are incorporated by reference herein. This application relates to U.S. Ser. No. 11/305,052, filed Dec. 19, 2005.

BACKGROUND OF THE INVENTION

The present invention relates to a system for transmitting a digital video signal and recording the received video signal. More particularly, the present invention relates to great extension of the range of use of a digital signal recording/reproducing system by greatly shortening a recording time through transmission of a video signal in a compressed form, and further relates to great extension of the range of use of a digital signal recording/reproducing system by making the number of signals to be recorded and a recording/reproducing time variable.

As a digital magnetic recording/reproducing system (hereinafter referred to as VTR) is conventionally known, for example, a D2 format VTR. In such a conventional digital VTR, the elongation or shortening of a reproducing time is possible by using variable-speed reproduction. However, the prior art reference does not at all disclose high-speed recording in which a recording time is shortened to 1/m, multiple recording in which a plurality of signals are recorded, and the compression/expansion of a recording/reproducing time.

The above-mentioned conventional digital VTR has a feature that a high quality is attained and there is no deterioration caused by dubbing. However, the shortening of a dubbing time is not taken into consideration. Therefore, for example, in the case where a two-hour program is to be recorded, two hours are required. Thus, there is a drawback

that inconveniences are encountered in use. Also, the multiplexing of recording signals is not taken into consideration. Therefore, for example, when two kinds of programs are to be simultaneously recorded or reproduced, two VTR's are required. This also causes inconveniences in use.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a digital VTR in which high-speed recording onto a tape can be made with the same format as that used in standard-speed recording, to provide a transmission signal processing system for transmitting at a high speed a video signal to be recorded by such a digital VTR, and to extend the range of use of the digital VTR by shortening a recording time. For example, the digital VTR can be used in such a manner that a two-hour program is recorded in about ten minutes and is reproduced at a standard speed.

The above object is achieved as follows. A video signal and an audio signal are subjected to time-base compression to 1/m, bit compression to 1/n, addition of a parity signal and modulation, and are thereafter transmitted or outputted. The transmitted signal is received, is subjected to demodulation, error correction, addition of a parity signal and modulation, and is thereafter recorded, onto a magnetic tape which travels at a travel speed m times as high as that upon normal reproduction, by use of a magnetic head on a cylinder which rotates at a frequency m times as high as that upon normal reproduction. The signal on the magnetic tape traveling at a travel speed upon normal reproduction is reproduced by a magnetic head on the cylinder which rotates at a frequency upon normal reproduction. The reproduced signal is subjected to demodulation, error correction, bit expansion of video and audio signals and D/A conversion, and is thereafter outputted. Address signals corresponding to a plurality of VTR's may be transmitted prior to a signal to be recorded. Further, control signals indicative of the start of recording and the stop of recording may be transmitted. The transmitted signals are received and error-corrected, and controls of the standby for recording, the start of recording and the stop of recording are made on the basis of the control signals.

With the above construction, since the video signal and the audio signal are time-base compressed to 1/m and bit-compressed to 1/n, a transmission time is shortened to 1/m and a signal band turns to m/n. The time-base compressed and bit-compressed signal is transmitted after addition of a parity signal for error correction and modulation to a code adapted for a transmission path. The transmitted signal is received and demodulated. The detection of an error produced in a transmitting system and the correction for the error can be made using the added parity signal. The error-corrected signal is added with a parity signal for correction for an error produced in a magnetic recording/reproducing system and is modulated to a code adapted for the magnetic recording/reproducing system. Upon recording, since the rotation frequency of the cylinder and the travel speed of the magnetic tape are increased by m times, the recording onto the magnetic tape can be made at an multiple speed. Upon reproduction, by setting the rotation frequency of the cylinder and the travel speed of the magnetic tape to normal ones, the reproduction at a normal speed can be made. The reproduced signal is code-demodulated. The detection of an error produced in the magnetic recording/reproducing system and the correction for the error can be made on the basis of the parity signal. By bit-expanding the video signal and the audio signal compressed by the transmission signal processing system, the original video

and audio signal can be restored. The bit-expanded signal is converted into an analog signal by a D/A converter. Simultaneous and selective control of the start/stop of recording for a multiplicity of VTR's can be made in such a manner that the address signals corresponding to the VTR's are transmitted prior to a signal to be recorded, the correction for an error of the received signal is made, required VTR's are brought into recording standby conditions by the corrected address signals, and the controls of the start of recording and the stop of recording are made by the transmitted control signals.

Another object of the present invention is to provide a digital signal recording/reproducing system in which multiple recording onto a tape can be made with the same format as that used in standard recording and simultaneous multiple reproduction is possible, and to extend the range of use of a digital VTR by compressing/expanding a recording/reproducing time in accordance with the transmission rate of a multiplexed input/output signal and the number of signals in the multiplexed input/output signal.

This object is achieved as follows. There are provided means for selecting one or plural desired signals from a time-base compressed and time-division multiplexed digital input signal, and helical scan recording means for making time-division multiplex recording of the selected signals with a time-base compressed speed after selection being retained. There is further provided means for reproducing the recorded signals with the rotation speed of a cylinder, a tape speed and so on being set to values proportional to the transmission rate of a reproduction signal and the number of signals to be simultaneously reproduced and with the signal being time-base expanded or being retained as time-base compressed.

With the above construction, N kinds of desired signals selected from the multiplexed input digital signal and time-base compressed to 1/K are subjected to time-division multiplex recording with a time-base compressed speed after selection being retained. Upon reproduction, for example, if both the cylinder rotation speed and the tape speed are set to N/K times, a recording track and a reproducing track coincide with each other and the use of a reproducing time K/N times as long as a recording time enables the reproduction of each of the N kinds of signals at a standard speed. Also, if both the cylinder rotation speed and the tape speed are set to (M×N)/K times, a recording track and a reproducing track coincide with each other and the use of a reproducing time as K/(M×N) times as long as the recording time enables the reproduction of each of the N kinds of signals at an M-tuple speed. In the case where L kinds of signals are selected from among the N kinds of reproduced signals and a processing speed at a reproduction signal processing circuit is set to L×M times as long as a standard reproduction processing speed, each of the L kinds of signals among the N kinds of multiple-recorded signals is outputted at a speed M times as high as a standard speed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a digital transmission signal processing system and a recording/reproducing system according to an embodiment of the present invention;

FIG. **2** is a block diagram of a recording/reproducing system according to another embodiment of the present invention;

FIG. **3** is a diagram for explaining the conventional parity adding method;

FIG. **4** is a block diagram of a recording/reproducing system according to still another embodiment of the present invention;

FIG. **5** is a block diagram of a digital transmission signal processing system and a recording/reproducing system according to a further embodiment of the present invention;

FIG. **6** shows the format of control signals used in one of applications of the present invention;

FIG. **7** is a block diagram of a still further embodiment of the present invention;

FIG. **8** shows one example of the specification of signals to be recorded;

FIG. **9** is a block diagram of a furthermore embodiment of the present invention;

FIGS. **10**, **11** and **12** are block diagrams of different examples of applications of the present invention;

FIG. **13** is a block diagram for explaining one example of the operation of the embodiment shown in FIG. **7**;

FIG. **14** is a timing chart showing the waveforms of signals involved in the example shown in FIG. **13**;

FIG. **15** is a block diagram for explaining another example of the operation of the embodiment shown in FIG. **7**;

FIG. **16** is a timing chart showing the waveforms of signals involved in the example shown in FIG. **15**;

FIG. **17** is a table showing some applications of the examples shown in FIGS. **13** and **15**;

FIG. **18** is a block diagram of a still furthermore embodiment of the present invention; and

FIGS. **19** and **20** are signal diagrams for explaining different operations of the embodiment shown in FIG. **18**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will now be explained by use of FIG. **1**. In the figure, reference numerals **1** and **40** denote magnetic tapes, numerals **2**, **3**, **41** and **42** magnetic heads, numerals **4** and **43** cylinders, numerals **5** and **44** capstans, numerals **10** and **50** servo control circuits, numerals **20**, **31** and **60** demodulation circuits, numerals **21**, **32** and **61** error correction circuits, numerals **22** and **23** compression circuits, numerals **24** and **33** parity addition circuits, numerals **25** and **34** modulation circuits, numerals **26** a transmission circuit, numeral **27** a transmission path, numeral **30** a reception circuit, numerals **62** and **63** expansion circuits, numerals **64** and **65** D/A conversion circuits, numeral **70** a video signal output terminal, and numeral **71** an audio signal output terminal.

Firstly, the operation of a transmission signal processing system will be explained. Digital video and audio signals recorded on the magnetic tape **1** are reproduced by the magnetic heads **2** and **3** mounted on the cylinder **4** and are inputted to the demodulation circuit **20**. The magnetic tape **1** travels by virtue of the capstan **5**. The travel speed of the magnetic tape **1** and the rotation frequency of the cylinder **4** are, for example, ten times as high as the tape travel speed and the cylinder rotation speed upon normal reproduction. Accordingly, the signal inputted to the demodulation circuit **20** is a signal time-compressed to one tenth. For example, a 120-minute signal recorded on the magnetic tape **1** can be reproduced in 12 minutes.

Generally, in the case where a digital signal is to be recorded on a magnetic recording medium, the signal is recorded after having been modulated into scrambled NRZ code, M^2 code or the like. The demodulation circuit **20** performs a demodulation processing, that is, a signal pro-

cessing for restoring the thus modulated signal into original digital data. The signal demodulated by the demodulation circuit **20** is inputted to the error correction circuit **21** in which erroneous data produced in a magnetic recording/reproducing process is detected and the correction for the erroneous data is made. Further, the signal is separated into a video signal and an audio signal which are in turn inputted to the compression circuits **22** and **23**, respectively. The video signal is bit-compressed through, for example, discrete cosine conversion. The audio signal is bit-compressed through, for example, non-linear quantization or differential PCM. As a result, the transmission rate of the video signal and the audio signal in total is reduced to, for example, one twentieth.

Output signals of the compression circuits **22** and **23** are inputted to the parity addition circuit **24** for performing a signal processing which includes adding a parity signal for error correction and outputting the video signal and the audio signal serially in accordance with a transmission format. A serial output signal of the parity addition circuit **24** is inputted to the modulation circuit **25**. In the modulation circuit **25**, the serial signal is modulated in accordance with the characteristic and the frequency band of the transmission path **27**. For example, in the case where the signal is transmitted in an electric wave form, quadruple phase shift keying (QPSK) is made. The modulated signal is inputted to the transmission circuit **26** from which it is outputted to the transmission path **27**.

As apparent from the foregoing explanation of the operation of the transmission signal processing system, it is possible to transmit a signal at a speed which is ten times as high as a normal speed.

The above embodiment has been shown in conjunction with the case where a signal from the VTR is reproduced. However, a signal source is not limited to the VTR and may include a magnetic disk device, an optical disk device or the like.

Next, explanation will be made of the operation of the VTR for receiving and recording the transmitted signal. The signal transmitted from the transmission signal processing system is received by the reception circuit **30**. The received signal is inputted to the demodulation circuit **31**. The demodulation circuit **31** is provided corresponding to the modulation, as provided by the modulation circuit **25**, such as QPSK modulation, for example, and demodulates the modulated signal to the original signal. The demodulated signal is inputted to the error correction circuit **32** in which the detection of and the correction for an error produced in the transmission path **27** are made on the basis of the parity signal added by the parity addition circuit **24**. At this time, in the case where the S/N ratio of the transmission system is not sufficient so that complete correction for the error is impossible, correction is made through, for example, signal replacement, by use of the signal correlation.

An output signal of the error correction circuit **32** is inputted to the parity addition circuit **33**. In the parity addition circuit **33**, a parity signal for detecting an error produced in a recording/reproducing process and making correction for the error is added. The parity-added signal is inputted to the modulation circuit **34**. In the modulation circuit **34**, the signal is modulated to scrambled NRZ code, M^2 code or the like as mentioned above. The modulated signal is recorded on the magnetic tape **40** by the magnetic heads **41** and **42** mounted on the cylinder **43**.

Since the signal supplied to the magnetic heads **41** and **42** is a signal which is time-base compressed to one tenth as compared with a signal upon normal operation, the servo control circuit **50** controls the cylinder **43** and the capstan **44** so that the rotation frequency of the cylinder **43** and the travel speed of the magnetic tape **40** become ten times as high as those upon normal recording. Also, in order to record a predetermined signal at a predetermined position on the magnetic, tape **40**, synchronization information is detected from the received signal to control the phase of rotation of the cylinder **41** on the basis of the detected synchronization information.

Next, the operation of the VTR for reproducing the thus recorded signal will be explained. Upon reproduction, the travel speed of the magnetic tape **40** and the rotation frequency of the cylinder **43** are set to those upon normal reproduction. The reproduced signal is inputted to the demodulation circuit **60**. The demodulation circuit **60** is provided corresponding to the modulation circuit **34** and demodulates the modulated signal. The demodulated signal is inputted to the error correction circuit **61** in which the detection of an error produced in the magnetic recording/reproducing system and the correction for the error are made on the basis of the parity signal added by the parity addition circuit **33**. In the case where there is an error which cannot be corrected, the error is properly corrected by use of the signal correlation. Also, the signal is outputted after having been separated into a video signal and an audio signal.

The video signal is inputted to the expansion circuit **62**. The expansion circuit **62** is provided corresponding to the compression circuit **22** and restores the compressed video signal into the original video signal. An output signal of the expansion circuit **62** is inputted to the D/A conversion circuit **64** and is converted thereby into an analog video signal which is in turn outputted from the terminal **70**.

The audio signal is inputted to the expansion circuit **63**. The expansion circuit **63** is provided corresponding to the compression circuit **23** and restores the compressed audio signal into the original audio signal. An output signal of the expansion circuit **63** is inputted to the D/A conversion circuit **65** and is converted thereby into an analog audio signal which is in turn outputted from the terminal **71**.

In the foregoing, the embodiment of the present invention has been shown and the operation thereof has been explained. According to the present invention, a video signal and an audio signal over a long time can be transmitted and recorded in a short time, thereby making it possible to extend the range of use of the digital VTR.

Another embodiment of the present invention is shown in FIG. **2**. FIG. **2** is partially similar to FIG. **1**. The same parts in FIG. **2** as those in FIG. **1** are denoted by the same reference numerals as those used in FIG. **1** and detailed explanation thereof will be omitted. The embodiment shown in FIG. **2** concerns a VTR in which a signal transmitted/received at a high speed can be recorded while being monitored.

In FIG. **2**, reference numeral **80** denotes a change-over switch, numeral **81** an error correction circuit, and numeral **82** a memory circuit. An error corrected video signal outputted from the error correction circuit **81** is inputted through the memory circuit **82** to a terminal R side of the change over switch **80** which is selected upon recording. The memory circuit **82** has a memory capacity for at least one field. The video signal received at a high speed is stored into a memory of the memory circuit **82** with the number of frames being reduced. The stored signal is read from the memory at a normal speed and is inputted to an expansion circuit **62**.

Upon reproduction, a video signal output of an error correction circuit **61** is inputted to a terminal P side of the

change-over switch **80** which is selected upon reproduction. Accordingly, the operation of the embodiment of FIG. **2** upon reproduction is similar to that of the embodiment shown in FIG. **1**.

In the embodiment shown in FIG. **2**, upon recording, the video signal outputted from the error correction circuit **81** is inputted to the expansion circuit **62** through the memory circuit **82**. Alternatively, an output signal of a modulation circuit **34** may be inputted to a demodulation circuit **60** through a memory circuit. Also, in the case where the operating speed of the demodulation circuit **60** or the error correction circuit **61** leaves a margin, a memory circuit may be properly placed at a post stage. Or, in the case where the storage capacity of the error correction circuit **61** or the expansion circuit **62** leaves a margin, the circuit may be used as a memory circuit or any additional memory circuit may be omitted.

As has been explained in the above, the embodiment shown in FIG. **2** makes it possible to record a received video signal while monitoring it in the form of a picture having a reduced number of frames.

In the embodiment shown in FIG. **1**, the parity signal is added in order to make the detection of and the correction for an error which may be produced in the transmission system or the magnetic recording/reproducing system. One example of a parity adding method is shown in FIG. **3** in conjunction with the case of a D2 format VTR. In the D2 format VTR, a signal for one field is divided into a plurality of segments for signal processing. FIG. **3** shows one segment. In FIG. **3**, reference numeral **90** represents a group of video data, numeral **91** a group of outer code parities, and numeral **92** a group of inner code parities. Firstly, outer code parities are added for data of the matrix-like arranged video data group **90** which lie in a vertical direction in FIG. **3**. Thereafter, inner code parities are added for data of the video data group **90** and the outer code parity group **91** lying in a horizontal direction in FIG. **3**, thereby producing a signal to be recorded. Though detailed explanation of the generation of parities will be omitted herein, the parities are generated in accordance with a generating function G(x).

In the embodiment shown in FIG. **1**, if the same parity generation manner is employed by the parity addition circuits **24** and **33**, the error correction circuits **32** and **61** may hold the most part thereof in common. Namely, since the error correction circuits **32** and **61** are circuits which are respectively used upon recording and upon reproduction, it is possible to reduce the circuit scale or size by using the most part of the circuits **32** and **61** in common.

Further, in the case where the same parity generation manner is employed by the parity addition circuits **24** and **33** in the embodiment shown in FIG. **1**, it is possible to further reduce the circuit scale or-size of the recording/reproducing system. The construction in that case is shown in FIG. **4** as still another embodiment of the present invention. FIG. **4** is partially common to FIG. **1** or **2**. The parts in FIG. **4** common to those in FIG. **1** or **2** are denoted by the same reference numerals as those used in FIG. **1** or **2** and detailed explanation thereof will be omitted.

The embodiment shown in FIG. **4** is based on a concept that an error produced in a transmission system and an error produced in a magnetic recording/reproducing system are simultaneously detected and corrected by an error correction circuit **61**. Accordingly, a signal received by a reception circuit **30** is demodulated by a demodulation circuit **31** and is inputted to a modulation circuit **34** without being subjected to error correction and parity addition. The subsequent processing is the same as that in the embodiment shown in FIG. **1** or **2**. Namely, a reproduced signal is inputted to the error correction circuit **61** after demodulation by a demodulation circuit **60**. As mentioned above, an error produced in the transmission system and an error produced in the magnetic recording/reproducing system are simultaneously detected and corrected by the error correction circuit **61** in the reproducing system.

In the embodiment shown in FIG. **4**, the error correction circuit **32** and the parity addition circuit **33** can be removed as compared with the embodiment shown in FIG. **1** or **2**, thereby making it possible to reduce the circuit scale.

Though having not been mentioned in the foregoing embodiments, in a helical scan VTR as shown, since a signal becomes discontinuous when a track jump is made upon reproduction, the recording is made with an amble signal being added to the heading portion of a signal. Since the addition of an amble signal is employed in the D2 format VTR, detailed explanation thereof will be omitted. Also, in order to define a starting position of a signal, a synchronizing signal is properly added. Since the addition of a synchronizing signal is known in, for example, the D2 format VTR, detailed explanation thereof will be omitted.

In the embodiment shown in FIG. **1**, the addition of an amble signal may be made by the parity addition circuit **24**. Alternatively, it may be made on the recording/reproducing system side in order to enhance the efficiency of use of the transmission path **27**. In this case, the addition of an amble signal can be made by the parity addition circuit **33**. As for the embodiment shown in FIG. **4**, in the case where the addition of an amble signal is to be made on the recording/reproducing system side, the amble signal can be added by the modulation circuit **34**. In the case where the addition of an amble signal is made on the recording/reproducing system side, it is possible to enhance the efficiency of use of the transmission path **27**. On the other hand, in the case where the addition of an amble signal is made on the transmission signal processing system side, the lowering of the cost of a VTR can be attained as a great effect when a signal is sent to a multiplicity of VTR's simultaneously.

FIG. **5** shows a further embodiment of the present invention in which the further reduction of the circuit scale of a VTR on the receiving side and hence the further lowering of the cost can be attained in the case where a signal is sent to a multiplicity of VTR's simultaneously.

FIG. **5** is partially common to FIG. **1**, **2** or **4**. The parts in FIG. **5** common to those in FIG. **1**, **2** or **4** are denoted by the same reference numerals as those used in FIG. **1**, **2** or **4** and detailed explanation thereof will be omitted. In FIG. **5**, reference numeral **100** denotes a modulation circuit. The embodiment shown in FIG. **5** is based on a concept that a signal processing required upon a recording mode of a VTR is performed on the transmitting side. Namely, modulation adapted for magnetic recording/reproduction, for example, a signal processing corresponding to the modulation circuit **34** shown in FIG. **4** is performed on the transmission signal processing system side. After parities have been added by a parity addition circuit **24** of the transmission signal processing system, the modulation adapted for the magnetic recording/reproduction is performed by the modulation circuit **100**. Therefore, modulation adapted for transmission is performed by a modulation circuit **25**. As a modulation system employed by the modulation circuit **100** is suitable a system which does not cause the extension of a frequency band by modulation, for example, scrambled NRZ. A signal modulated by the modulation circuit **25** is transmitted to a transmission path **27** through a transmission circuit **26** in a manner to that in the embodiment shown in FIG. **1**.

The signal received by a reception circuit **30** through the transmission path **27** is inputted to a demodulation circuit **31** in which the signal is subjected to demodulation corresponding to the modulation circuit **25**. Since the signal demodulated by the demodulation circuit **31** is one which has already been subjected by the modulation circuit **10** to the modulation adapted for the magnetic recording/reproduction, the signal is recorded on a magnetic tape **40** by magnetic heads **41** and **42** as it is. As a result, the same recording as that in the embodiment shown in FIG. **4** is made. An operation upon reproduction is similar to that in the embodiment shown in FIG. **4**.

As apparent from the above, the present embodiment makes it possible to remarkably reduce the circuit scale of the VTR.

According to one of applications of the present invention, it is possible to transmit a signal from a transmission signal processing system to a multiplicity of VTR's through a transmission path simultaneously and at a high speed, as has already been mentioned. In this case, it is difficult to control a multiplicity of VTR's simultaneously. Further, it is required to make a control which causes specified ones of the VTR's to perform recording operations and specified others of the VTR's not to perform recording operations. A technique for realizing such a control will be shown just below.

For the above purpose, control signals are transmitted prior to transmission of a signal to be recorded. One example of the control signals is shown in FIG. **6**. In the figure, reference numeral **110** denotes a synchronizing signal, numeral **111** an ID signal indicative of a control to be made, numeral **112** an address signal indicative of a VTR to be controlled, numeral **113** a control signal for bringing a VTR designated by the address signal **112** into a recording mode, numeral **114** a control signal for stopping the recording, numerals **115** and **116** blank signals, and numeral **120** a recording signal to be actually recorded.

The ID signal **111** indicating the transmission of the address signals **112** indicative of VTR's in which a signal is to be recorded, is transmitted at a predetermined position relative to the synchronizing signal **110** to bring each VTR into a standby condition. After all the address signals have been transmitted, the ID signal **113** is transmitted to start the recording of the signal **120** in the designated VTR's. After the signal **120** has been transmitted, the ID signal **114** to control the stop of recording is transmitted. Each of the blank signals **115** and **116** is a signal for conforming a signal transmission format to the other transmission signal and is therefore an insignificant signal portion.

In the embodiments shown in FIGS. **1** and **5**, those control signals are produced by a control signal generation circuit **130** and are transmitted with parities which are added by the parity addition circuit **24** for making correction for an error produced during transmission.

In the VTR shown in FIG. **1**, the control signals are detected by a control circuit **131** after the reception by the reception circuit **30**, the demodulation by the demodulation circuit **31** and the correction by the error correction circuit **32** for an error produced during transmission to make a control for the recording and the stop of recording in the recording/reproducing system.

In the case of the VTR's shown in FIGS. **4** and **5**, an output signal of the demodulation circuit **31** is inputted to the error correction circuit **61** for a need of making correction for an error produced during transmission and error-corrected control signals are inputted to a control circuit **131**. In a change-over circuit **132**, the terminal R side for selecting an output signal of the demodulation circuit **31** is selected upon recording and the terminal P side for selecting an output signal of the demodulation circuit **60** is selected upon reproduction.

As apparent from the foregoing, the present embodiment makes it possible to control a multiplicity of VTR's selectively and simultaneously.

Also, the use of the change-over circuit **132** and a memory circuit makes it possible to record a signal while monitoring it in the form of a picture having a reduced number of frames, as explained in conjunction with the embodiment shown in FIG. **2**.

Next, a still further embodiment of the present invention will be explained by use of FIG. **7**. In the figure, reference numeral **301** denotes an input terminal for standard analog video signal, numeral **302** an input terminal for standard digital video signal, numeral **303** an input terminal for high-speed digital video signal, numeral **305** a recording system mode change-over switch, numeral **306** a recording system change-over signal generation circuit, numeral **310** an A/D converter, numeral **320** a change-over circuit, numeral **330** a data compression circuit, numeral **340** a change-over circuit, numeral **350** a recording system signal processing circuit for performing a signal processing which includes addition of error correction code and modulation for recording, numeral **370** a cylinder, numeral **371** a magnetic tape, numerals **372** and **372'** magnetic heads, numeral **380** a reproducing system signal processing circuit for performing a signal processing which includes demodulation for reproduction, error detection and error correction. Numeral **390** a change-over circuit, numeral **400** a data expansion circuit, numeral **420** a D/A converter, numeral **431** an output terminal for standard analog video signal, numeral **432** an output terminal for standard digital video signal, numeral **433** an output terminal for high-speed digital video signal, numeral **435** a reproducing system mode change-over switch, and numeral **436** a reproducing system change-over signal generation circuit.

The present embodiment is an example of a digital magnetic recording/reproducing system which has recording modes of standard-speed recording and high-speed recording and reproduction modes of standard-speed reproduction and high-speed reproduction. FIG. **8** shows one example of the specification of input video signals.

Firstly, explanation will be made of standard-speed recording. A digital signal into which an analog video signal inputted from the input terminal **301** is converted by the A/D converter **310** or an equivalent digital signal which is inputted from the input terminal **302**, is switched or selected by the change-over circuit **320**, is subjected to a predetermined data compression processing by the data compression circuit **330** and is thereafter inputted to a terminal **340***a* of the changeover circuit **340**. In the change-over circuit **340**, a change-over to connect the terminal **340***a* and a terminal **340***c* is made by a change-over signal from the recording system change-over signal generation circuit **306**. Thereby, the data-compressed signal is inputted to the recording system signal processing circuit **350**. In the recording system signal processing circuit **350**, a signal processing such as channel division, addition of error correction code and modulation for recording is performed at a predetermined processing clock adapted for the data-compressed signal. Thereafter, the signal is supplied to the magnetic heads **372** and **372'** mounted on the cylinder **370** so that it is recorded onto the magnetic tape **371**. The cylinder **370** and the magnetic tape **371** are controlled by a servo control circuit **360**. The servo control circuit **360** controls a cylinder motor

and a capstan motor so as to provide a cylinder rotation speed and a tape speed for standard speed and so as to be synchronized with the input video signal.

Next, explanation will be made of high-speed recording. A high-speed digital video signal inputted from the input terminal **303** is sent to a terminal **340***b* of the change-over circuit **340**. Since the high-speed digital video signal is a signal which has already been subjected to a data compression processing, it is not necessary to pass the signal through the data compression circuit **330**. A change-over to connect the terminal **340***b* and the terminal **340***c* is made by a change-over signal from the recording system change-over signal generation circuit **306** so that the high-speed digital video signal is inputted to the recording system signal processing circuit **350**. In the recording system signal processing circuit **350**, a signal processing similar to that in the case of the standard-speed recording is performed at a predetermined processing clock adapted for the high-speed digital video signal. Thereafter, the signal is supplied to the magnetic heads **372** and **372'** mounted on the cylinder **370** so that it is recorded onto the magnetic tape **371**. The cylinder **370** and the magnetic tape **371** are controlled by the servo control circuit **360**. The servo control circuit **360** control the cylinder motor and the capstan motor so as to provide a predetermined cylinder rotation speed and a predetermined tape speed and so as to be synchronized with the input video signal.

In the present invention, the recording onto the tape can be made with the quite same format in both the standard-speed recording and the high-speed recording, thereby making it possible to greatly shorten a recording time in the high-speed recording mode.

Next, explanation will be made of a signal processing upon reproduction. In the present embodiment, the recording pattern on the magnetic tape is the same whichever of the standard-speed recording and the high-speed recording is selected as a recording mode. Therefore, either standard-speed reproduction or high-speed reproduction can be selected irrespective of the recording mode.

Firstly, the standard-speed reproduction will be explained. The servo control circuit **360** controls the cylinder motor and the capstan motor so that a cylinder rotation speed and a tape speed for standard speed are provided. A signal reproduced by the magnetic heads **372** and **372'** is inputted to the reproducing system signal processing circuit **380**. In the reproducing system signal processing circuit **380**, a signal processing such as demodulation for reproduction, channel synthesis, error detection and error correction is performed at a predetermined processing clock adapted for the standard-speed reproduction. Thereafter, the signal is supplied to a terminal **390***a* of the change-over circuit **390**. In the change-over circuit **390**, a changeover to connect the terminal **390***a* and a terminal **390***c* is made upon standard-speed reproduction by a change-over signal from the reproducing system change-over signal generation circuit **436**. Thereby, the reproduced signal is supplied to the data expansion circuit **400**. In the data expansion circuit **400**, a signal processing reverse to the data compression processing upon recording is performed so that the signal is restored to the original signal. Thereby, the original transmission rate is restored. The data-expanded reproduction signal is sent to the D/A converter **420** on one hand to be outputted as an analog video signal from the output terminal **431** after D/A conversion and is sent to the output terminal **432** on the other hand to be outputted as a digital video signal therefrom.

Next, explanation will be made of the high-speed reproduction. The servo control circuit **360** controls the cylinder motor and the capstan motor so that a predetermined cylinder rotation speed and a predetermined tape speed adapted for the high-speed reproduction are provided. A signal reproduced by the magnetic heads **372** and **372'** is inputted to the reproducing system signal processing circuit **380**. In the reproducing system signal processing circuit **380**, a signal processing such as demodulation for reproduction, channel synthesis, error detection and error correction is performed at a predetermined processing clocks adapted for the high-speed reproduction. Thereafter, the high-speed reproduction signal is supplied to the terminal **390***a* of the change-over circuit **390**. In the change-over circuit **390**, a change-over to connect the terminal **390***a* and a terminal **390***b* is made upon high-speed reproduction. Thereby, the high-speed digital video signal is outputted from the output terminal **433**.

A furthermore embodiment of the present invention will be explained by use of FIG. **9**. The construction of the present embodiment is similar to that of the embodiment shown in FIG. **7** but is different therefrom in that the change-over circuit **340** is placed at a different position, the change-over circuit **390** used in FIG. **7** is eliminated and a change-over circuit **345** is newly added.

An input/output signal upon standard-speed recording/reproduction in the present embodiment is the same as that in the embodiment shown in FIG. **7**. As for high-speed recording and high-speed reproduction, however, the present embodiment is different from the embodiment of FIG. **7** in that the transmission of a high-speed digital video signal is made in the form of a recording format. Accordingly, upon high-speed recording, the high-speed digital video signal is not passed through a recording system signal processing circuit **350** but is recorded onto a tape through the change-over circuit **340** as it is. Upon high-speed reproduction, a reproduced signal is subjected to a signal processing for reproduction such as error detection and error correction by a reproducing system signal processing circuit **380** and is thereafter inputted to a terminal **345***b* of the change-over circuit **345**. The signal supplied through the change-over circuit **345** to the recording system side signal processing circuit **350** is subjected to a signal processing for recording such as addition of error correction code and modulation for recording by the signal processing circuit **350** to form a recording format and is thereafter outputted as a high-speed digital video signal from an output terminal **433**.

The embodiments shown in FIGS. **7** and **9** have feature that high-speed recording and high-speed reproduction are possible. The best use of this feature can be made for dubbing or data communication with the result of effective shortening of a dubbing time, a data communication time or a data circuit line occupation time. Also, though those embodiments have been mentioned in conjunction with an example in which all of standard-speed recording, high-speed recording, standard-speed reproduction and high-speed reproduction modes are involved, it is not necessarily required to implement all of those modes. There may be considered an example in which only a necessary mode is provided in compliance with the purpose of use. FIG. **10** shows an embodiment in which a high-speed recording function is provided as a recording mode and at least a high-speed reproduction function is provided as a reproduction mode. Also, there may be considered an embodiment as a system for the exclusive use for reproduction in which at least a high-speed reproduction function is provided, as shown in FIG. **11**. Further, FIG. **12** shows an embodiment in which a high-speed recording function is provided as a

recording mode and a standard-speed reproduction function is provided as a reproduction mode.

FIG. **13** is a block diagram of one example of the magnetic recording/reproducing system of the embodiment of FIG. **7** for explaining processings subsequent to the compression processing. In FIG. **13**, reference numeral **201** denotes a synchronization detection circuit, numeral **204** a recording modulation circuit, numeral **205** a cylinder servo control circuit, numeral **206** a capstan servo (or tape speed) control circuit, numeral **207** a reproduction reference signal generation circuit, numeral **210** a demodulation circuit, numeral **211** a cylinder, numeral **212** a pair of recording heads, numeral **213** a pair of reproducing heads, numeral **214** a capstan which controls the tape speed, numeral **215** a magnetic tape, numeral **216** a delivery reel, and numeral **217** a take-up reel. FIG. **14** is a timing chart of input and output signals in the example shown in FIG. **13** and schematically illustrate a compressed picture signal **251** which is an input signal, a synchronizing signal **252** of the picture signal, a standard-speed reproduction signal **255** which is an output signal, and a reproduction synchronizing signal **256**.

In the shown example, n-tuple speed recording is realized by making a tape speed and a cylinder rotation speed upon recording ntimes as high as those upon standard-speed reproduction. As shown in FIG. **14**, the compressed video signal as an input signal of the circuit shown in FIG. **13** and the synchronizing signal include information **251** for n pictures and n synchronizing pulses **252** synchronous therewith in a time when one picture is reproduced at a standard speed. The picture information is converted into a predetermined recording format by the recording modulation circuit **204** and is recorded onto the magnetic tape **215** by the recording heads **212**. At this time, a synchronizing signal for the cylinder servo control circuit **205** and the capstan-servo control circuit **206** is increased by n times in compliance with the n-tuple speed video signal, as shown by **252** in FIG. **14**, so that the rotation speed of the cylinder **211** and the feed speed of the magnetic tape **215** are increased by n times. Thereby, the recording onto the tape can be made with the quite same recording format as that in the case of the standard-speed recording. Upon reproduction, a synchronizing signal for the cylinder servo control circuit **205** and the capstan servo control circuit **206** is supplied from the reproduction reference signal generation circuit **207** to restore the cylinder rotation speed and the tape feed speed to those upon standard-speed reproduction, and a signal read by the reproducing heads **213** is demodulated by the demodulation circuit **210** and is outputted therefrom. In the circuit shown in FIG. **13**, if the input video signal and the synchronizing signal are ones of standard speed, standard-speed recording is possible. Also, n-tuple speed reproduction is possible if the frequency of an output signal from the reproduction reference signal generation circuit is increased by n times.

FIG. **15** is a block diagram of another example of the magnetic recording/reproducing system of the embodiment of FIG. **7** for explaining processings subsequent to the compression processing. FIG. **16** is a timing chart of input and output signals in the example shown in FIG. **15**. In FIG. **15**, the same reference numerals as those used in FIG. **13** denote the same or equivalent components as or to those shown in FIG. **13**. In FIG. **15**, reference numeral **202** denotes a ÷m circuit, numeral **203** recording system memories, numeral **208** a ÷m circuit, and numeral **209** reproducing system memories. In FIG. **16**, the same reference numerals as those used in FIG. **14** denote the same or equivalent signals as or to those shown in FIG. **14**. In FIG. **16**, reference numeral **253** denotes outputs of the recording system memories **203** and numeral **254** denotes an output of the ÷m circuit **208** or a synchronizing signal divided by m.

The embodiment shown in FIG. **15** is an example in which m pairs of recording heads are used to simultaneously record magnetic signals for m pictures on m tracks, thereby realizing high-speed recording while suppressing an increase in the cylinder rotation speed. Upon reproduction, m pairs of reproducing heads are used. Though FIG. **15** shows the case where two pairs of recording heads **212** are used to simultaneously record information for two pictures on two tracks, three or more pairs of heads can be used in a similar manner.

FIG. **17** is a table showing some examples of the tape speed and the cylinder rotation speed (rpm) in the embodiments shown in FIGS. **13** and **15**. In the table, high-speed recording or reproduction at a speed ten times as high as the standard speed is shown by way of example. Design for implementing another high-speed recording or reproduction is similarly possible. In the table shown in FIG. **17**, examples (①, ② and ③ correspond to the embodiment shown in FIG. **13** and examples ④ and ⑤ correspond to the embodiment shown in FIG. **15**.

A still furthermore embodiment of a digital signal recording/reproducing system of the present invention will be explained by use of a block diagram shown in FIG. **18**.

In FIG. **18**, reference numeral **501** denotes a signal input terminal to which a plurality of video signals are inputted in a time-division multiplex form, numeral **502** a recording selection signal-input terminal to which a recording selection signal for selecting one or plural signals to be recorded from the multiplexed input signal is inputted, numeral **503** a recording signal selection circuit for selecting the signals to be recorded from the multiplexed input signal in accordance with the recording selection signal from the input terminal **502**, numeral **504** a recording signal processing circuit for subjecting the selected signals to a digital processing for recording onto a recording medium, numerals **505** and **505'** magnetic heads, numeral **506** a rotating drum, numeral **507** a magnetic tape or the recording medium, numeral **508** a servo circuit for controlling the rotation of the drum **506** and the travel of the tape **507**, numeral **511** a reproduction selection signal input terminal to which a reproduction selection signal for selecting one or plural signals to be outputted as a reproduction signal from among the multiple-recorded and reproduced signals is inputted, numeral **509** a reproduction signal selection circuit for selecting the signals to be outputted as a reproduction signal from among the multiple-recorded and reproduced signals in accordance with the reproduction selection signal from the input terminal **511**, numeral **510** a reproduction signal processing circuit for subjecting the selected signals to a digital processing, and numeral **512** a reproduction signal output terminal.

The time-division multiplexed input video signal from the signal input terminal **501** is supplied to the recording signal selection circuit **503**. The recording signal selection circuit **503** is also supplied with the recording selection signal from the recording selection signal input terminal **502** to make the selection of signals to be recorded. For example, in the case where six kinds of video signals A, B, C, D, E and F are inputted in a time-division multiplex form as shown in (a) of FIG. **19** and four signals A, B, C and D thereof are to be selected and recorded, an output of the recording signal selection circuit **503** is as shown in (b) of FIG. **19**. Such an output signal of the recording signal selection circuit **503** is inputted to the recording signal processing circuit **504** which

in turn performs a signal processing for recording such as addition of error correction code. Also, the recording signal selection circuit **503** produces a speed control signal on the basis of the number of signals in the time-division multiplexed input video signal, the transmission rate of the input signal and the number of signals to be recorded which are selected by the recording selection signal. The speed control signal is supplied to the recording signal processing circuit **504** and the servo circuit **508**. For example, in the case where the input video signal is time-division multiplexed to sextuplet with each of six signals in the multiplexed input signal being transmitted at a rate time-base compressed to ⅙ and four signals among the six signals in the multiplexed input signal are to be selectively recorded, a signal indicative of a quadruple speed is produced as the speed control signal. Also, in the case where the input video signal is time-division multiplexed to sextuplet with each of six signals in the multiplexed input signal being transmitted at a rate time-base compressed to 1/12 and four signals among the six signals in the multiplexed input signal are to be selectively recorded, a signal indicative of a octuple speed is produced as the speed control signal. Namely, in the case where an input signal is multiplexed to N-plet, the compression rate of each of the N signals in the multiplexed input signal is 1/K and the number of signals to be selectively recorded is L, a speed control signal indicative of an (L×K)/N-tuple speed is produced. The operating speed of the recording signal processing circuit **504** which processes a signal from the recording signal selection circuit **503**, is changed in accordance with the speed control signal. For example, in the case of a speed control signal indicative of a quadruple speed, the recording signal processing circuit **504** performs a signal processing at a speed four times as high as a normal speed and supplies the processed signal to the magnetic heads **505** and **505'**. Here, for example, in the case where the input video signal is time-division multiplexed to sextuplet with each of the six signals in the multiplexed input signal being transmitted at a rate time-base compressed to ⅙ and a speed control signal indicative of a quadruple speed is used to selectively record four signals from among the six signals, the speed of an input signal inputted to the recording signal processing circuit **504** is four times as high as that of one video signal having a normal speed and the recording signal processing circuit **504** processes this quadruple-speed input signal at a quadruple speed and supplies the processed signal to the magnetic heads, thereby making it possible to record all of the four selected signals. Also, if the recording signal selection circuit **503** is constructed so that signals to be selectively recorded are sequentially changed for every one track on the tape, compatibility can be held in regard to the number of signals to be selectively recorded and a processing speed by causing the recording signal processing circuit **504** to perform a completed processing for every one track. In the following, explanation will be made in conjunction with the case where each video signal is recorded in such a form completed for every track. However, it should be noted in advance that the present invention is applicable to another recording system, for example, a system in which signals are recorded in a form changed for every pixel, line or field. On the other hand, the servo circuit **508** supplied with the speed control signal indicative of the quadruple speed controls the rotation speed of the rotating drum **506** so that it becomes four times as high as a normal speed and the travel speed of the magnetic tape **507** so that it becomes four times as high as a normal speed. Thereby, four signals A, B, C and D are alternately recorded on successive tracks of the magnetic tape **507**, as shown in FIG. **20**. According to the control mentioned above, the pattern of recording tracks on the tape becomes the same irrespective of the number of signals in the multiplexed input signal, the transmission rate of each signal and the number of signals to be selectively recorded. In order to make a control upon reproduction easy, it is preferable that the number of selectively recorded signals and the identification codes or signal numbers thereof (for example, A, B, C and D or 0, 1, 2 and 3) are recorded as an ID signal for every track.

In the above example, the recording of the time-division multiplexed signal has been mentioned. However, it is needless to say that the present invention is also applicable to the case where the number of multipet signal components in an input video signal is 1 or the input video signal is not multiplexed. In such a case, since the recording signal processing circuit **504** and the servo circuit **508** operate at speeds proportional to the transmission rate of the input video signal, an effect is manifested, for example, in high-speed dubbing. As apparent from the foregoing explanation of the operation, it is of course that a multiplexed signal can be recorded at a high speed.

Upon reproduction, a signal reproduced from the magnetic tape **507** by the magnetic heads **505** and **505'** mounted on the rotating drum **506** is inputted to the reproduction signal selection circuit **509**. The reproduction signal selection circuit **509** produces a speed control signal, for example, by detecting the number of multiple-recorded signals from the ID signal included in the reproduced signal and sends the speed control signal to the servo circuit **508**. The speed control signal is a signal indicative of a speed four times as high as the normal reproduction speed in the case where the number of multiple-recorded signals is 4 and a signal indicative of a sextuple speed in the case where it is 6. In the case of the quadruple speed, the servo control circuit **508** supplied with the speed control signal indicative of the quadruple speed controls the rotation speed of the rotating drum **506** so that it becomes four times as high as a normal speed and the travel speed of the magnetic tape **7** so that it becomes four times as high as a normal speed. Thereby, there can be traced all of signals recorded so that the recording track pattern on the tape becomes the same irrespective of the number of signals to be selectively recorded. In a system which has not a signal indicative of the number of selectively recorded signals, there may be employed a method in which the speed control signal is manually set. In a system in which the number of signals to be recorded on the tape is fixed, the speed control signal has a fixed value. The reproduction signal selection circuit **509** receives a reproduction selection signal inputted from the reproduction selection signal input terminal **511** to select a desired signal(s) from among the signals reproduced by the magnetic heads **505** and **505'** and to output the selected signal as a reproduction signal to the reproduction signal processing circuit **510**. The reproduction signal selection circuit **509** also outputs a selection number signal indicative of the number of selected signals to the reproduction signal processing circuit **510**.

The reproduction signal processing circuit **510** performs a signal processing such as code error correction processing and picture signal processing for the reproduction signal at a processing speed corresponding, to the selection number signal and outputs the processed reproduction signal from the output terminal **512**. For example, in the case where the number indicated by the selection number signal is 2, the signal processing speed is two times as high as a normal speed and various processings are performed for each selected signal. For example, in the case where signals A and

C are selected, the signals A and C are outputted alternately for each field. In the case where the number indicated by the selection number signal is 1, for example, when the reproduction selection signal from the reproduction selection signal input terminal **511** selects only the signal C, the reproduction signal processing circuit **510** performs the signal processing at the normal speed to output the signal as reproduced at a normal speed. As apparent from the above, the present embodiment makes it possible to simultaneously record any number of signals selected from among a plurality of signals in a multiplexed video signal and to simultaneously reproduce any number of signals from among the recorded signals.

In the case where a plurality of signals are simultaneously reproduced, a construction for outputting the reproduced signals from separate output terminals simultaneously and in parallel may be employed, particularly, in the case of an analog output, as a method other than the construction in which the plurality of reproduced signals are outputted in a time-division multiplex form, as mentioned above. Though in the above-mentioned example the reproduction signal is outputted at a reproduction speed for a usual video signal, the transmission rate of the reproduction signal may be made higher than the reproduction speed for the usual video signal in order to transmit the reproduction signal to another system in an analog or digital signal form at a high rate or to perform high-speed dubbing which is one of effects of the present embodiment. This can be realized in such a manner that the fundamental operating speed of there producing system is set to be higher than a normal reproduction speed and the operating speeds of the servo circuit **508**, the reproduction signal selection circuit **509** and the reproduction signal processing circuit **510** are changed in accordance with the number of multiple-recorded signals and/or the number of signals to be outputted as a reproduction signal with the above fundamental speed being the standard. If the transmission rate of a reproduction signal is made variable so that a rate adapted for a transmission path to which the reproduction signal is to be connected or the performance or function of a recorder by which the reproduction signal is to be recorded, can be selected.

As mentioned above, according to the present embodiment, it is possible to simultaneously record any number of signals selected from among a plurality of signals in a multiplexed video signal and to reproduce any number of signals from among the recorded signals at any speed. Also, in the case where a plurality of signals are selected and reproduced and the plurality of reproduced signals are simultaneously outputted in a time-division multiplex form or from separate output terminals in parallel, it is possible to arbitrarily set the transmission rate of an output signal.

The present embodiment has been explained in conjunction with the case where the present invention is applied to a helical-scan digital-recording VTR. It is of course that a similar effect can be obtained in the case where the present invention is applied to a fixed head VTR. The fixed head system is convenient for the structuring of a system since it has a higher degree of freedom for the setting of the units of division of a signal subjected to time-division multiple recording as compared with the helical scan system. Also, it is of course that the present invention is applicable to a recording/reproducing equipment other than the VTR or is applicable to a digital signal processing and analog recording system.

The present invention can be applied to not only the case where an input signal is time-division multiplexed, as mentioned above, but also the case where a plurality of signals are inputted simultaneously and in parallel. In the latter case, the recording signal selection circuit **503** is constructed to receive the input signals in parallel.

As has been mentioned in the foregoing, according to the present invention, it is possible to realize a digital VTR in which high-speed recording onto a tape can be made with the same format as that used in standard-speed reproduction. Further, there can be realized a transmission signal processing for transmitting at a high rate a video signal to be recorded by such a digital VTR. Also, in the case where a signal transmitted from the transmission signal processing system is to be recorded by a multiplicity of VTR's, it is possible to designate those ones of the multiplicity of VTR's by which recording is to be made and to make a control of the start/stop of recording.

What is claimed is:

1. An apparatus for receiving digital information including at least one of digital video information and digital audio information, comprising:

a receiver which receives the digital information that has digital video information bit-compressed by a first compression system, digital audio information bit-compressed by a second compression system, and error-detection information added to both the digital video information and the digital audio information;

a demodulator which demodulates the digital information received by the receiver;

an error detector which detects an error of digital information demodulated by the demodulator by use of the error-detection information;

a first expander which bit-expands video information among the digital information error detected by the error detector corresponding system; and

a second expander which bit-expands audio information among the digital information error detected by the error detector corresponding to the second compression system.

2. An apparatus according to claim **1**, wherein the first compression system and the second compression system are different systems.

3. An apparatus according to claim **1**, wherein the demodulator affects QPSK demodulation.

4. An apparatus according to claim **1**, further comprising;

an output terminal which outputs the digital information error-detected by the error detector to a recording/reproducing apparatus;

an input terminal which inputs a reproduced signal from the recording/reproducing apparatus; and

a selector which selects one of the digital information error-detected by the error detector and the digital information inputted from the input terminal;

wherein the digital information selected by the selector is bit-expanded by the first expander and the second expander.

5. An apparatus according to claim **1**, wherein the first compression system uses a discrete cosine transform, the received digital information is phase-modulated, and the demodulator demodulates the digital information received by the receiver in accordance with the phase-modulation.

6. An apparatus for processing a transmitted digital signal including at least one of a video signal and an audio signal, comprising:

a receiver which receives the transmitted digital signal, wherein the transmitted digital signal includes a video

signal bit-compressed by a first compression method, an audio signal bit-compressed by a second compression method, and an error correction signal added commonly to both the video signal and the audio signal;

a demodulator which demodulates the digital signal received by the receiver;

an error corrector which corrects an error of the digital signal demodulated by the demodulator based on the error correction signal;

a first expander which bit-expands the video signal of the digital signal corrected by the error corrector in accordance with the first compression method; and

a second expander which bit-expands the audio signal of the digital signal corrected by the error corrector in accordance with the second compression method.

7. The apparatus according to claim **6**, wherein the first compression method utilizes a discrete cosine transform.

* * * * *

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Arai et al.

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(54) **APPARATUS AND METHOD FOR RECEIVING AND RECORDING DIGITAL INFORMATION**

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See application file for complete search history.

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(57) **ABSTRACT**

A digital information receiving apparatus and method in which a receiver receives a digital signal including a video signal and an audio signal, wherein the received video signal is bit-compressed by a first compression method and the received audio signal is bit-expanded by a second compression method which is different from the first compression method, a demodulator demodulates the received digital signal, and an expander bit-expands the demodulated digital signal.

32 Claims, 18 Drawing Sheets

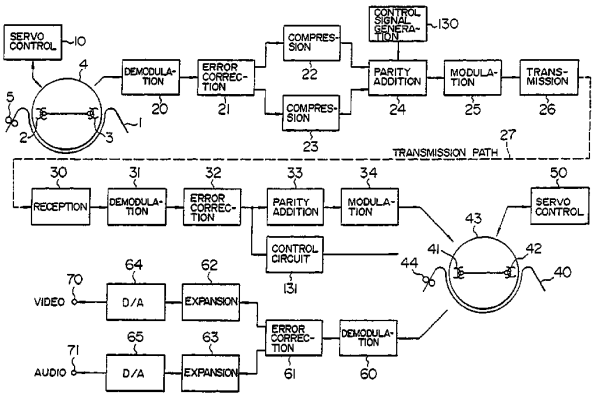

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FIG. 1

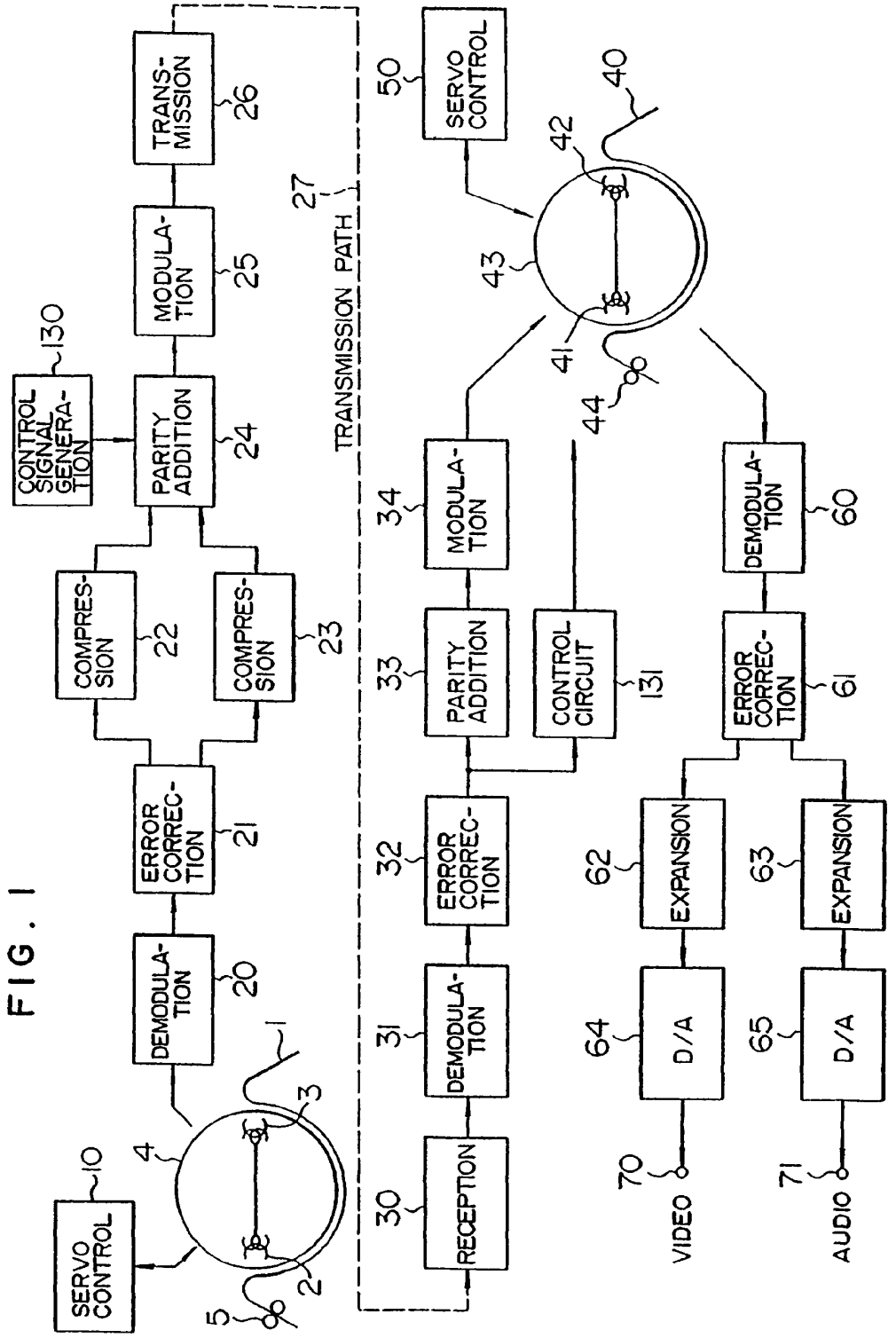

SERVO CONTROL
10
DEMODULATION
20
ERROR CORRECTION
21
COMPRESSION
22
COMPRESSION
23
PARITY ADDITION
24
CONTROL SIGNAL GENERATION
130
MODULATION
25
TRANSMISSION
26
TRANSMISSION PATH
27
RECEPTION
30
DEMODULATION
31
ERROR CORRECTION
32
PARITY ADDITION
33
MODULATION
34
CONTROL CIRCUIT
131
SERVO CONTROL
50
DEMODULATION
60
ERROR CORRECTION
61
EXPANSION
62
EXPANSION
63
D/A
64
D/A
65
VIDEO
70
AUDIO
71
1
2
3
4
5
40
41
42
43
44

FIG. 2

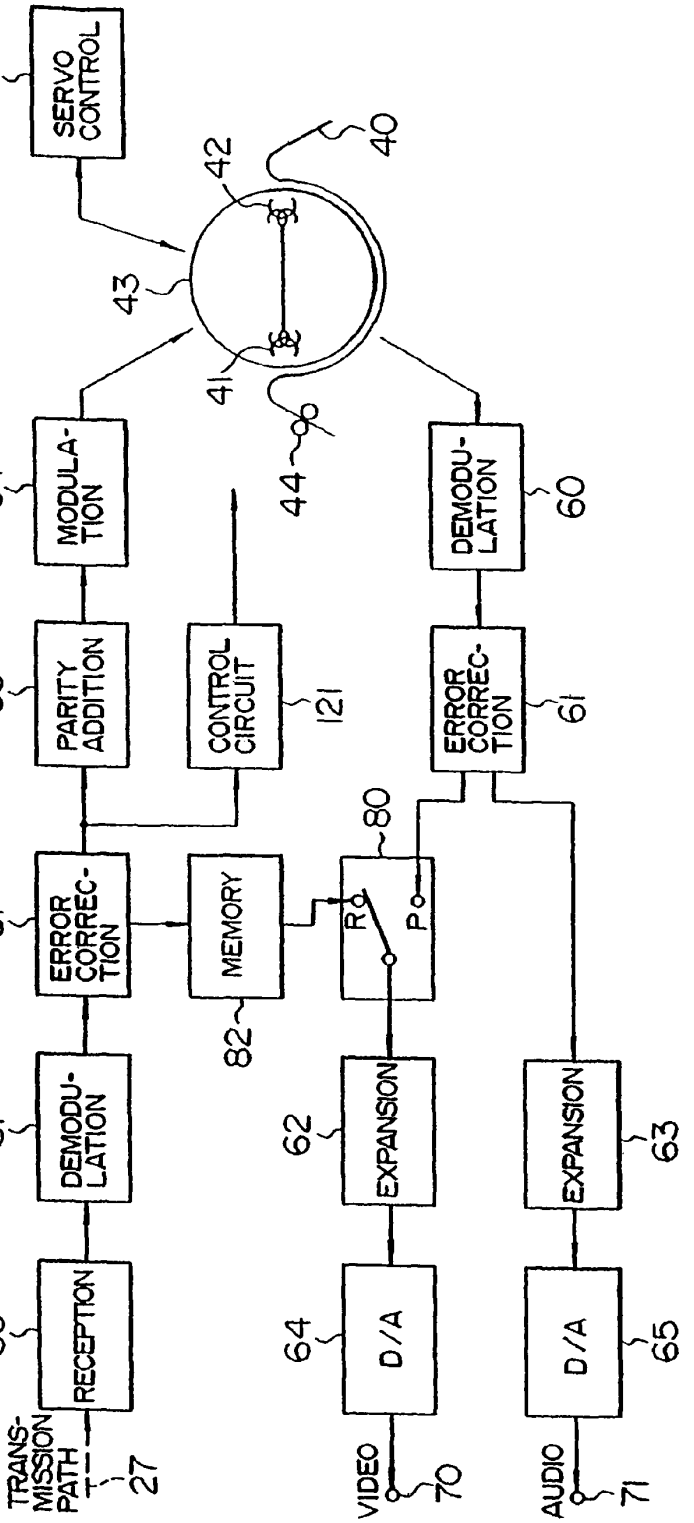

50
SERVO CONTROL
42
40
43
41
44
34
MODULA-TION
DEMODU-LATION
60
33
PARITY ADDITION
CONTROL CIRCUIT
121
ERROR CORREC-TION
61
80
81
ERROR CORREC-TION
MEMORY
82
R
P
31
DEMODU-LATION
62
EXPANSION
63
EXPANSION
30
RECEPTION
64
D/A
65
D/A
TRANS-MISSION PATH
27
VIDEO
70
AUDIO
71

FIG. 3

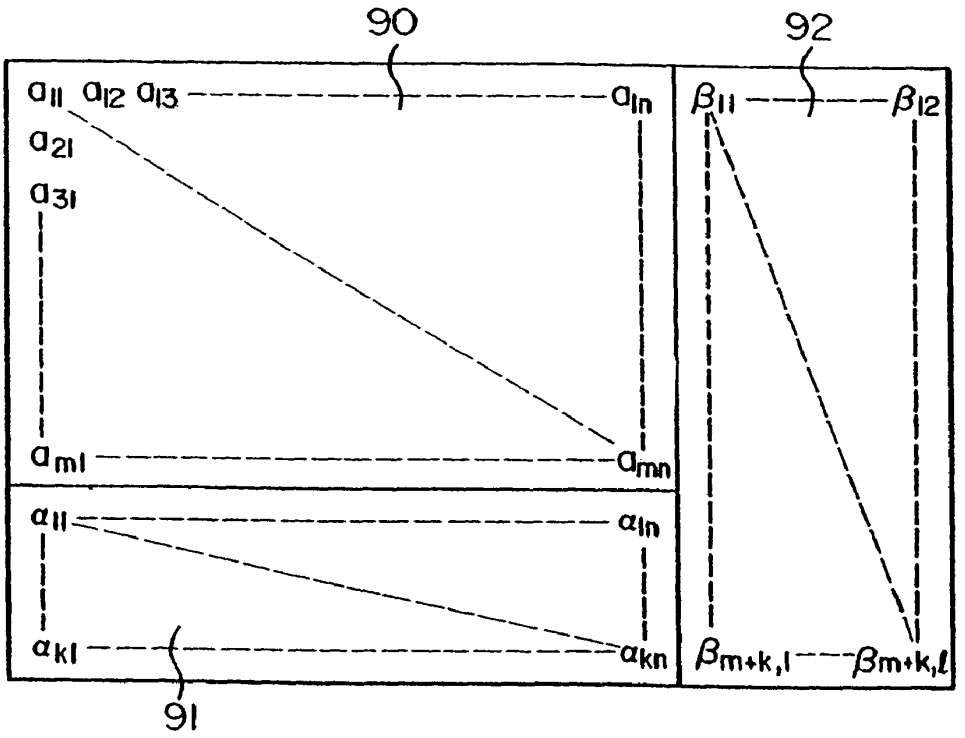
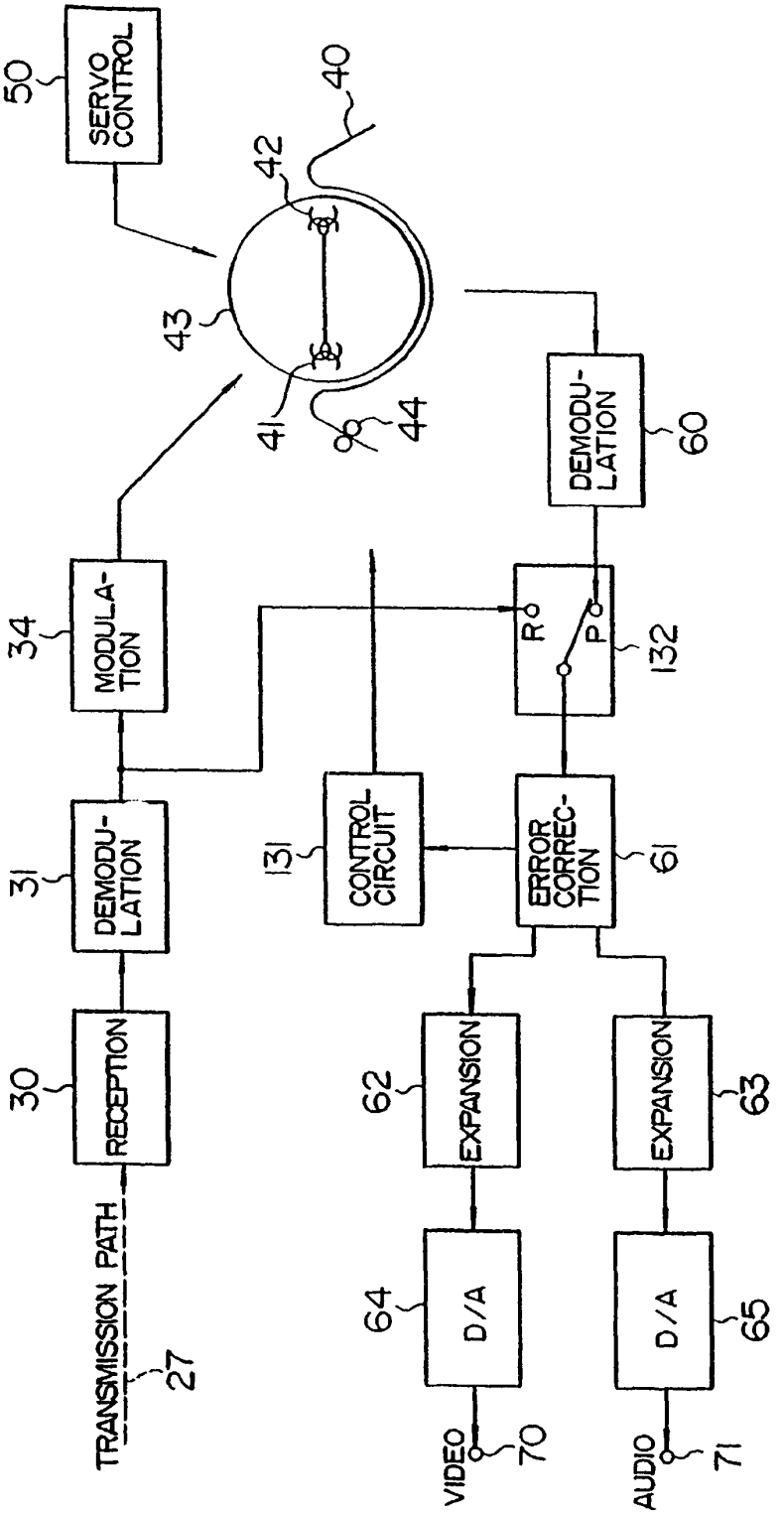


FIG. 4


50
SERVO CONTROL
40
42
43
41
44
DEMODU-LATION
60
34
MODULA-TION
R
P
132
31
DEMODU-LATION
131
CONTROL CIRCUIT
ERROR CORREC-TION
61
30
RECEPTION
62
EXPANSION
63
EXPANSION
TRANSMISSION PATH
27
64
D/A
65
D/A
VIDEO
70
AUDIO
71

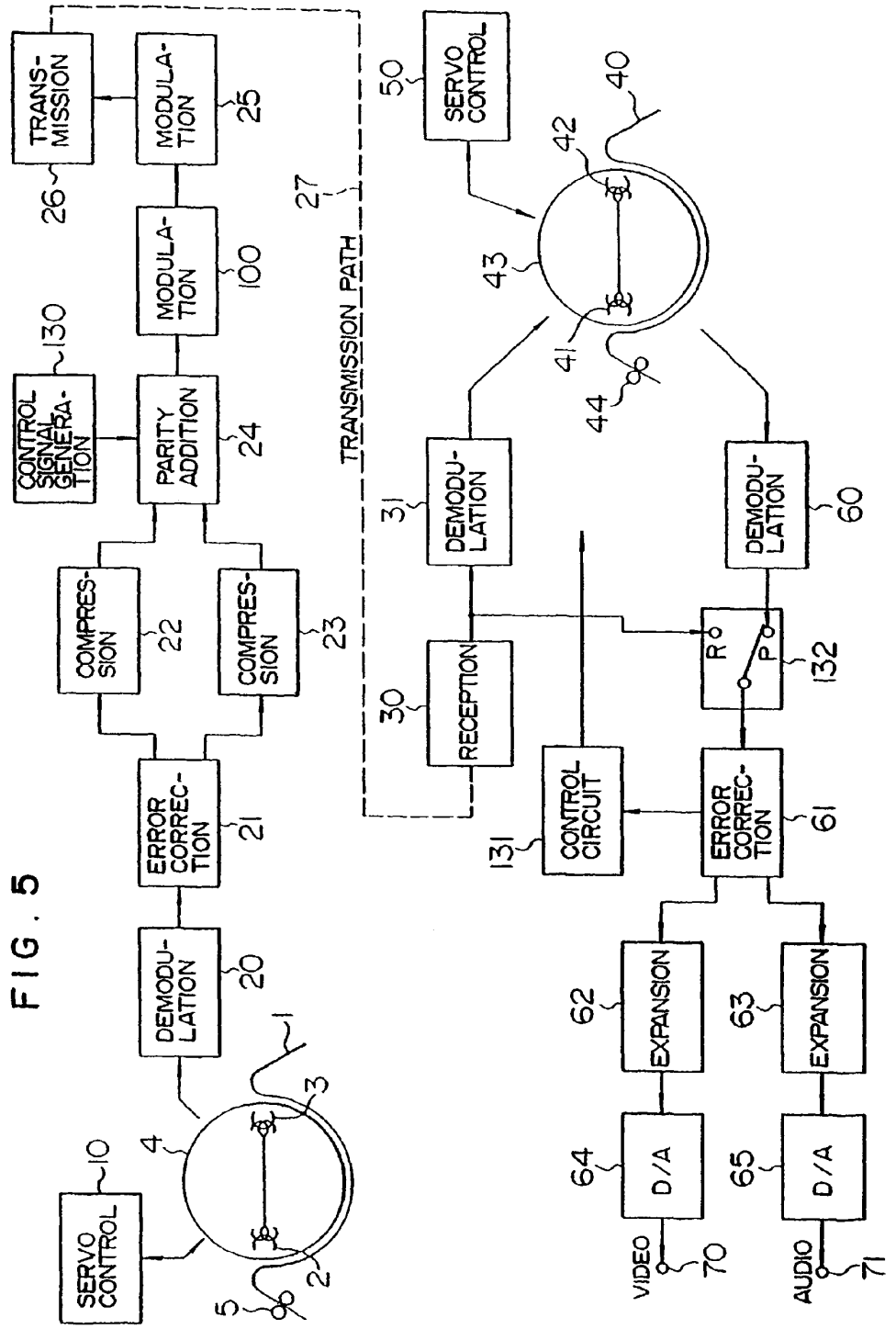

TRANSMISSION PATH
SERVO CONTROL
10
DEMODULATION
20
ERROR CORRECTION
21
COMPRESSION
22
COMPRESSION
23
PARITY ADDITION
24
CONTROL SIGNAL GENERATION
130
MODULATION
100
MODULATION
25
TRANSMISSION
26
27
SERVO CONTROL
50
DEMODULATION
31
RECEPTION
30
CONTROL CIRCUIT
131
DEMODULATION
60
ERROR CORRECTION
61
R
P
132
EXPANSION
62
EXPANSION
63
D/A
64
D/A
65
VIDEO
70
AUDIO
71
1
2
3
4
5
40
41
42
43
44

FIG. 5

FIG. 6

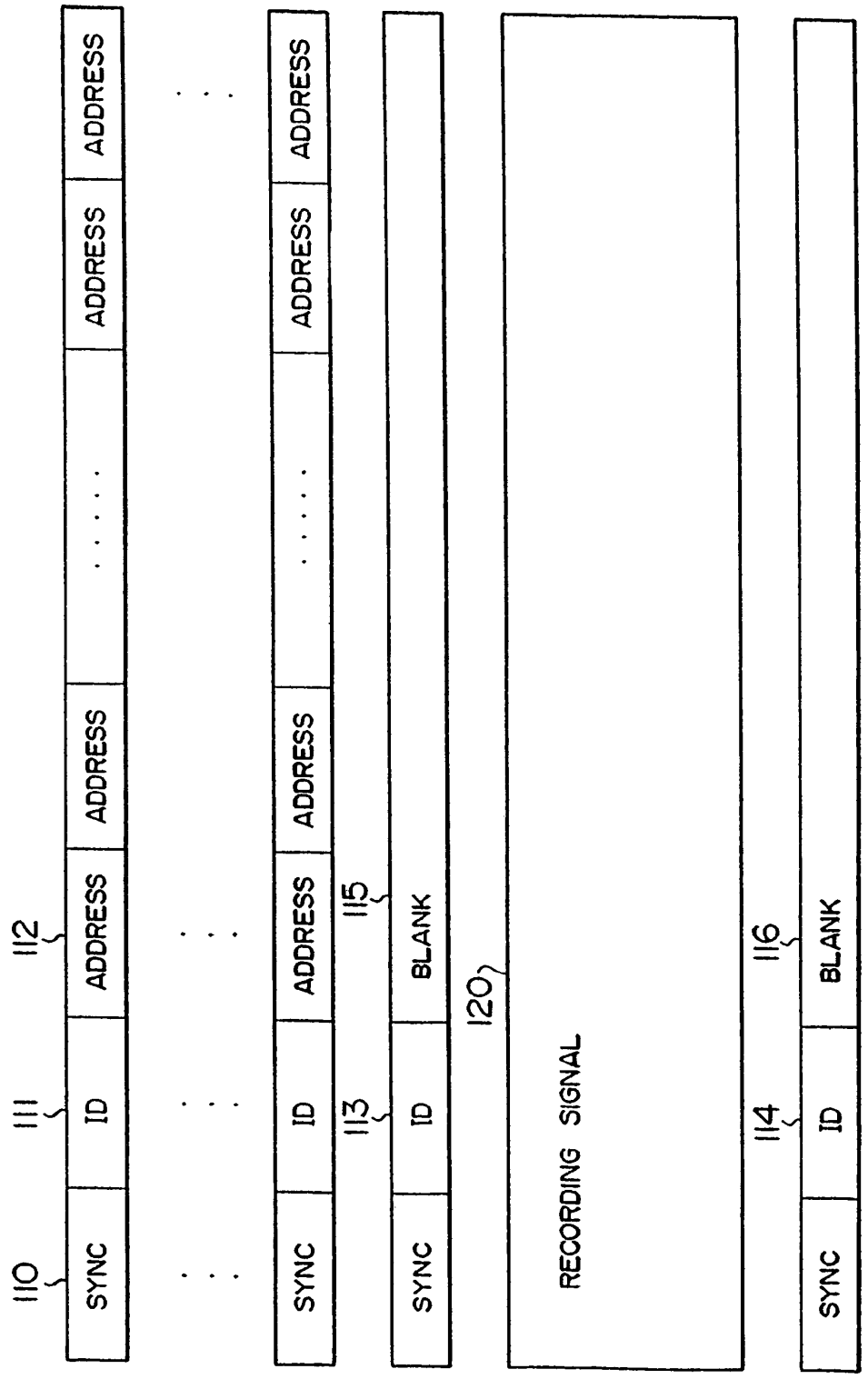

110
111
112
113
114
115
116
120
SYNC
ID
ADDRESS
BLANK
RECORDING SIGNAL

FIG. 7

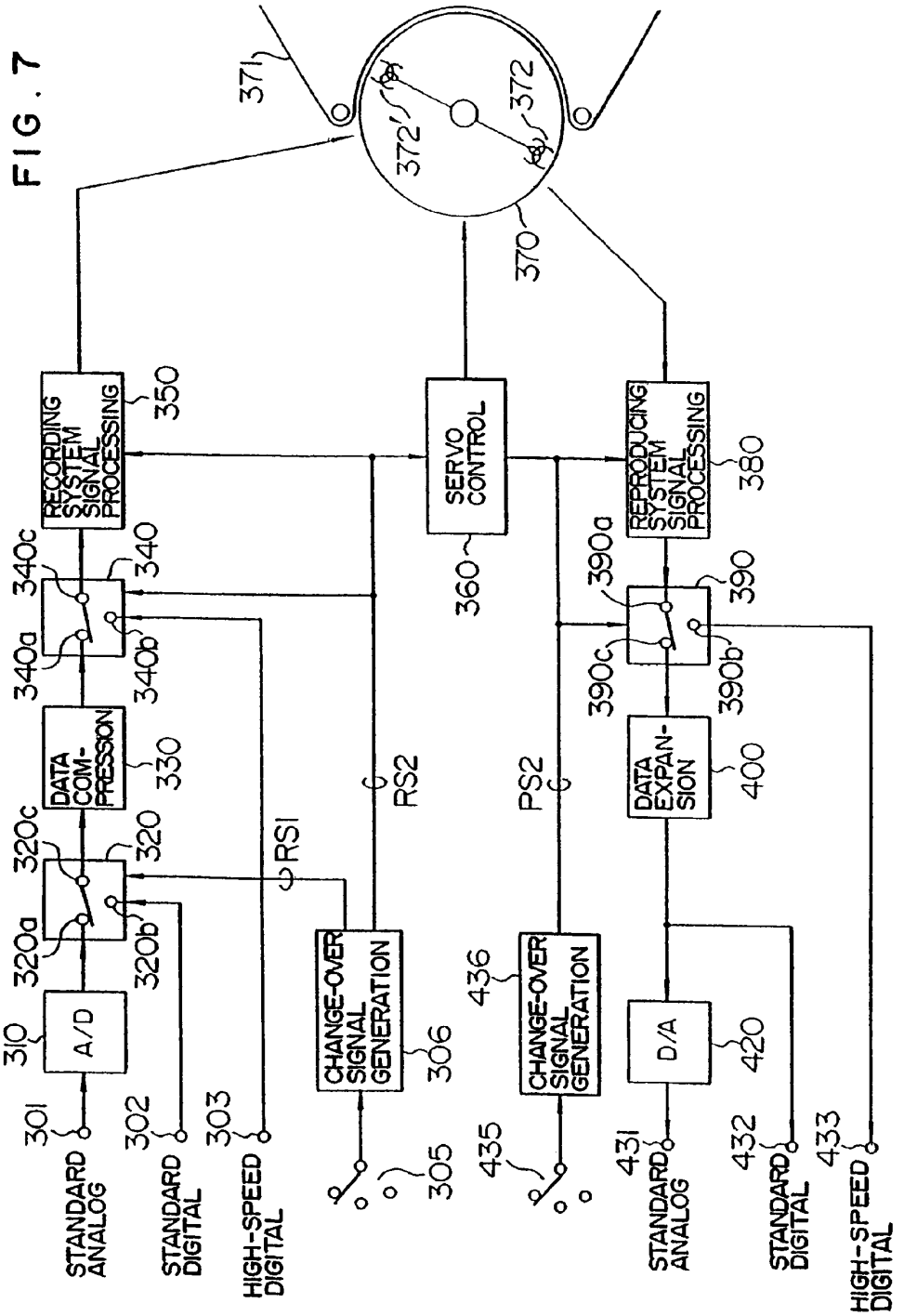

371
372
372'
370
RECORDING SYSTEM SIGNAL PROCESSING
350
SERVO CONTROL
360
REPRODUCING SYSTEM SIGNAL PROCESSING
380
340c
340
340a
340b
390a
390
390c
390b
DATA COM-PRESSION
330
DATA EXPAN-SION
400
320c
320
320a
320b
RS1
RS2
PS2
310
A/D
CHANGE-OVER SIGNAL GENERATION
306
436
CHANGE-OVER SIGNAL GENERATION
D/A
420
301
302
303
305
435
431
432
433
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL

FIG. 8

ITEM / INPUT		FIELD FREQUENCY	TRANSMISSION RATE	DATA COMPRESSION	TIME-BASE COMPRESSION
STANDARD SPEED	ANALOG	59.94 Hz	(AFTER A/D) 114 Mbps	ABSENCE	ABSENCE
	DIGITAL		114 Mbps		
HIGH SPEED	DIGITAL	59.94 Hz	100 Mbps	PRESENCE 1/11.4	PRESENCE 1/10

FIG. 9

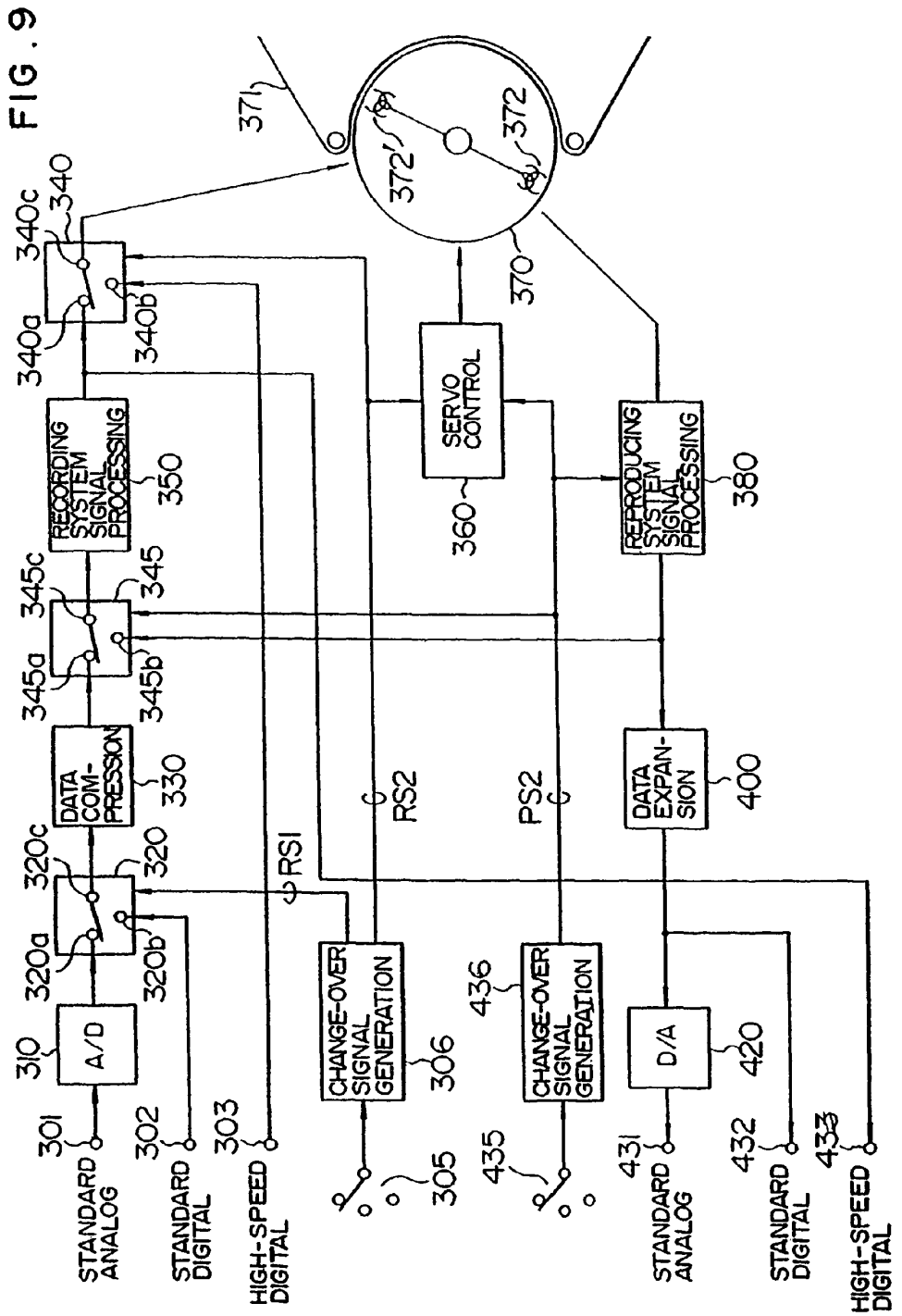

371
372
372'
370
340
340c
340a
340b
SERVO CONTROL
360
RECORDING SYSTEM SIGNAL PROCESSING
350
REPRODUCING SYSTEM SIGNAL PROCESSING
380
345
345c
345a
345b
DATA COM-PRESSION
330
DATA EXPAN-SION
400
RS2
PS2
RS1
320
320c
320a
320b
310
A/D
CHANGE-OVER SIGNAL GENERATION
306
436
D/A
420
301
302
303
305
435
431
432
433
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL
STANDARD ANALOG
STANDARD DIGITAL
HIGH-SPEED DIGITAL

FIG. 10

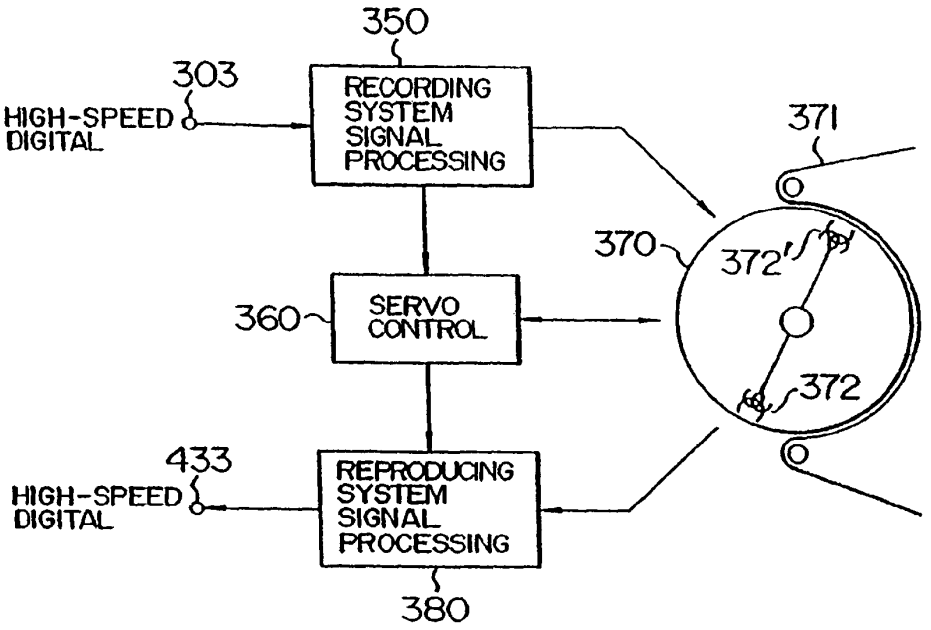

350
303
HIGH-SPEED DIGITAL
RECORDING SYSTEM SIGNAL PROCESSING
371
370
372'
360
SERVO CONTROL
372
433
HIGH-SPEED DIGITAL
REPRODUCING SYSTEM SIGNAL PROCESSING
380

FIG. 11

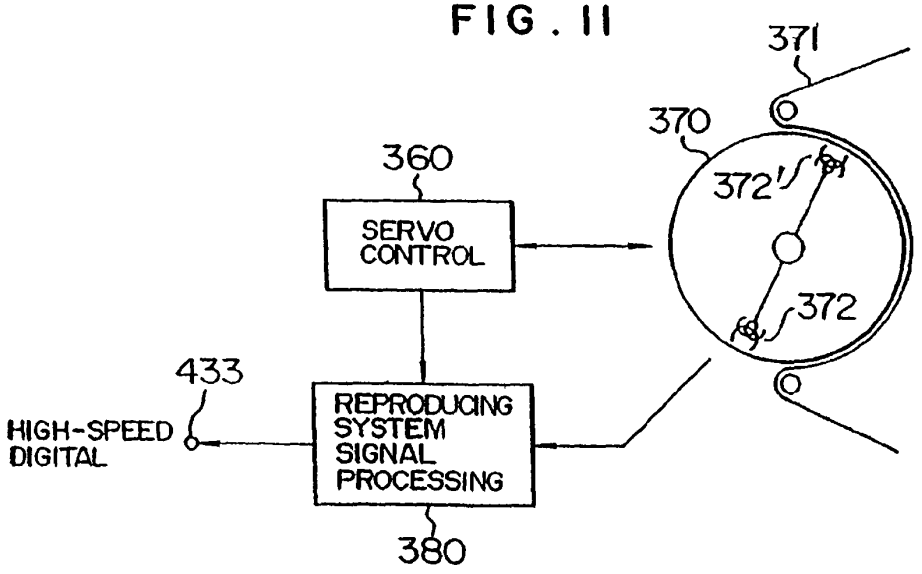

371
370
360
372'
SERVO CONTROL
372
433
HIGH-SPEED DIGITAL
REPRODUCING SYSTEM SIGNAL PROCESSING
380

FIG. 12

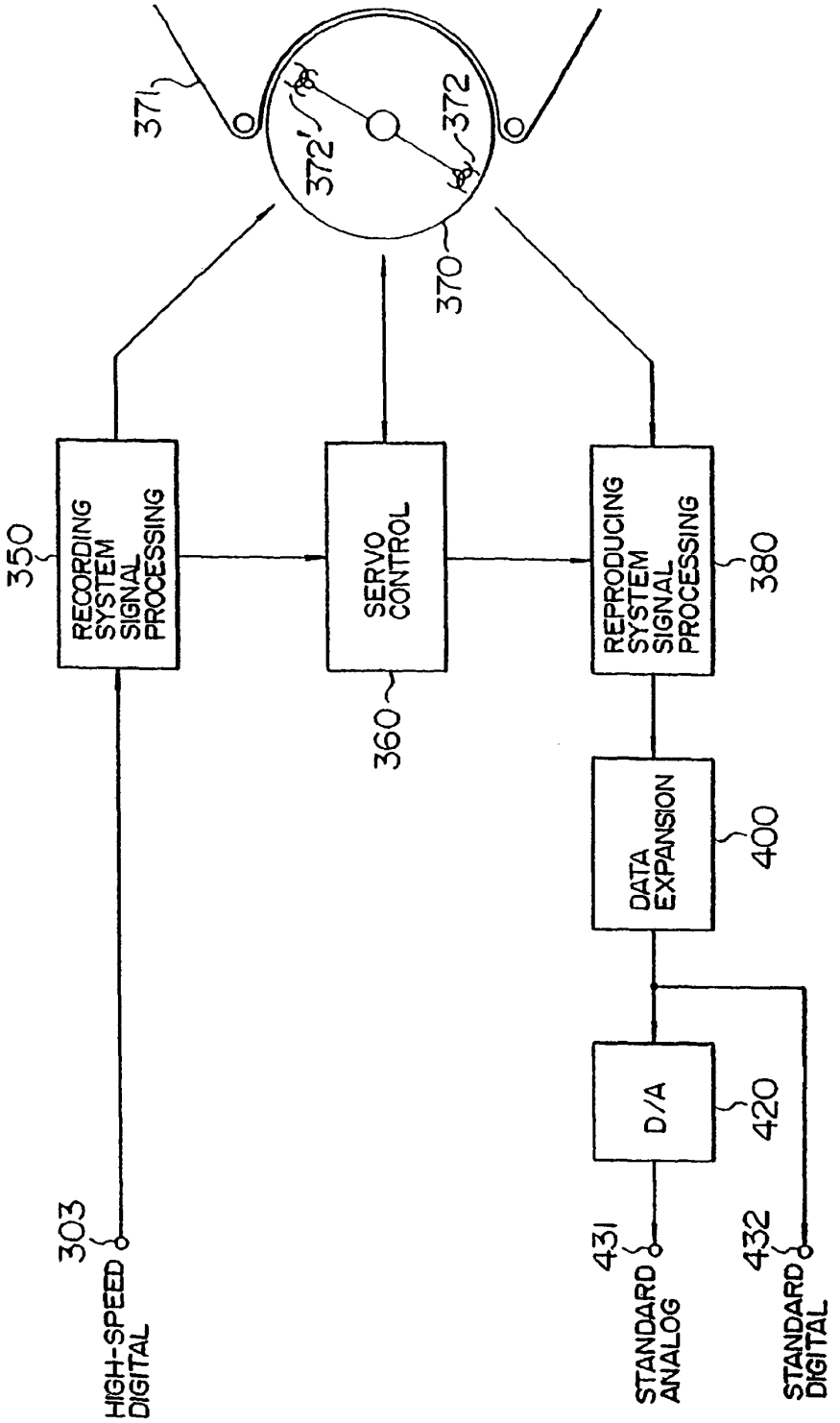

371
372'
372
370
350
RECORDING SYSTEM SIGNAL PROCESSING
SERVO CONTROL
360
REPRODUCING SYSTEM SIGNAL PROCESSING
380
DATA EXPANSION
400
D/A
420
303
HIGH-SPEED DIGITAL
431
STANDARD ANALOG
432
STANDARD DIGITAL

FIG. 13

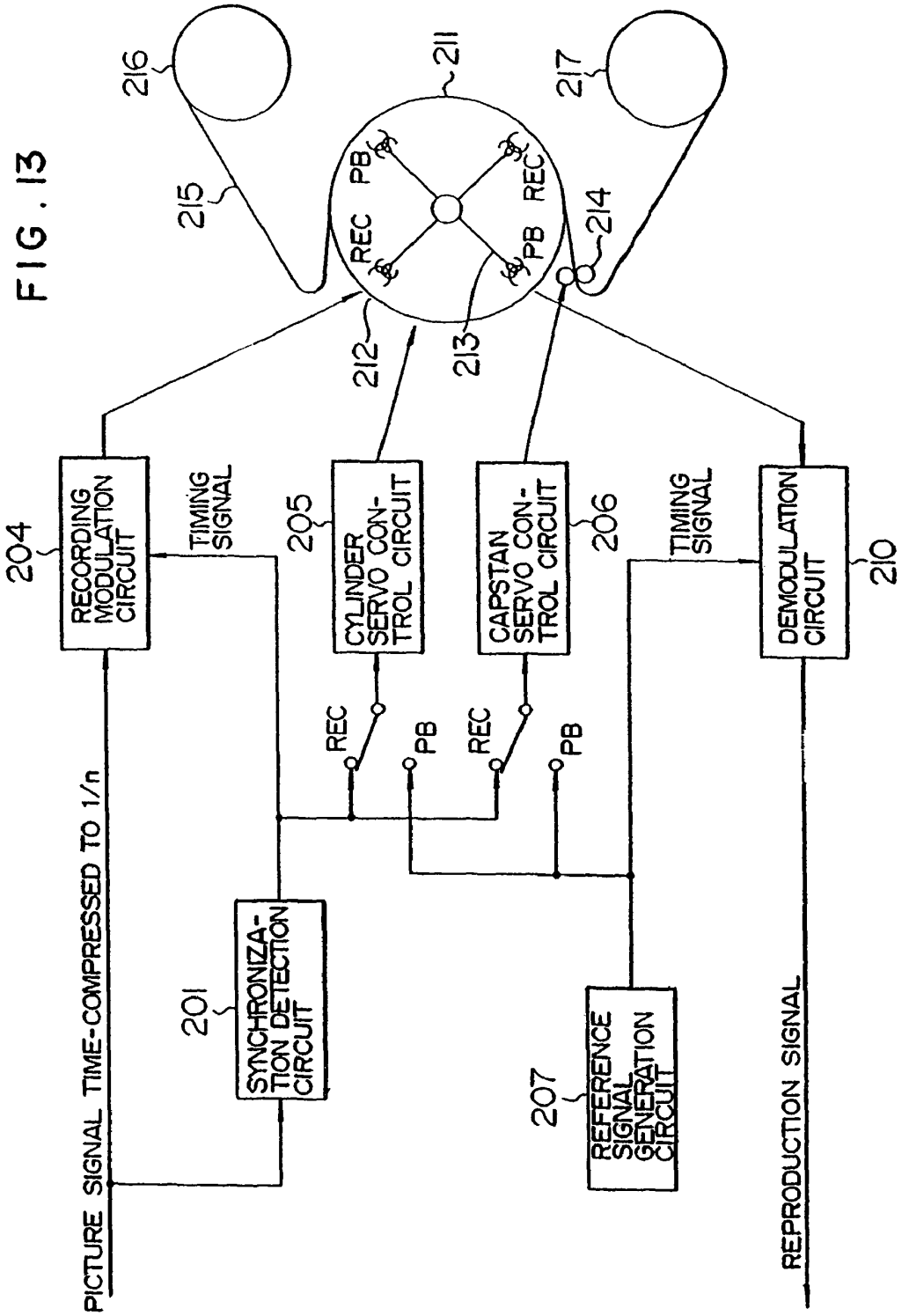

216
211
217
215
214
212
213
REC PB
PB REC
204
RECORDING MODULATION CIRCUIT
TIMING SIGNAL
205
CYLINDER SERVO CONTROL CIRCUIT
206
CAPSTAN SERVO CONTROL CIRCUIT
TIMING SIGNAL
210
DEMODULATION CIRCUIT
REC
PB
REC
PB
PICTURE SIGNAL TIME-COMPRESSED TO 1/n
201
SYNCHRONIZATION DETECTION CIRCUIT
207
REFERENCE SIGNAL GENERATION CIRCUIT
REPRODUCTION SIGNAL

FIG. 14

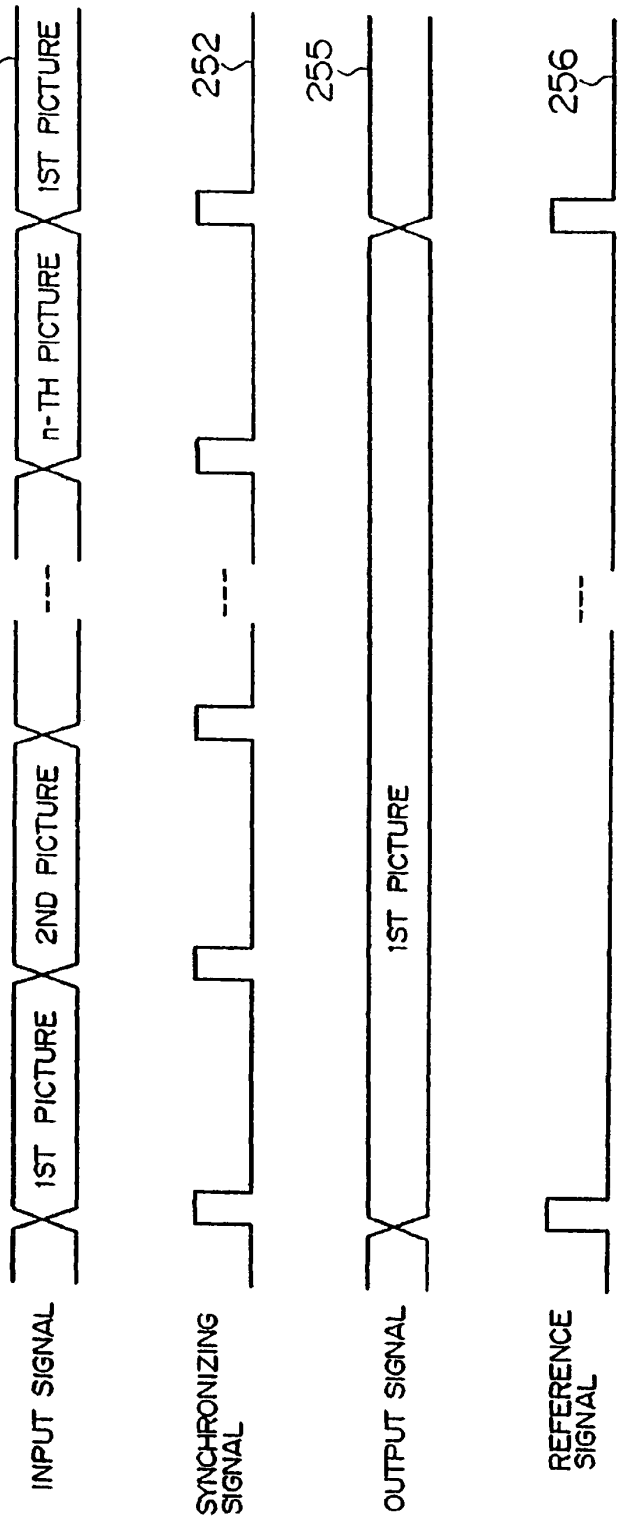

251
252
255
256
1ST PICTURE
2ND PICTURE
n-TH PICTURE
1ST PICTURE
INPUT SIGNAL
SYNCHRONIZING SIGNAL
OUTPUT SIGNAL
REFERENCE SIGNAL

FIG. 15

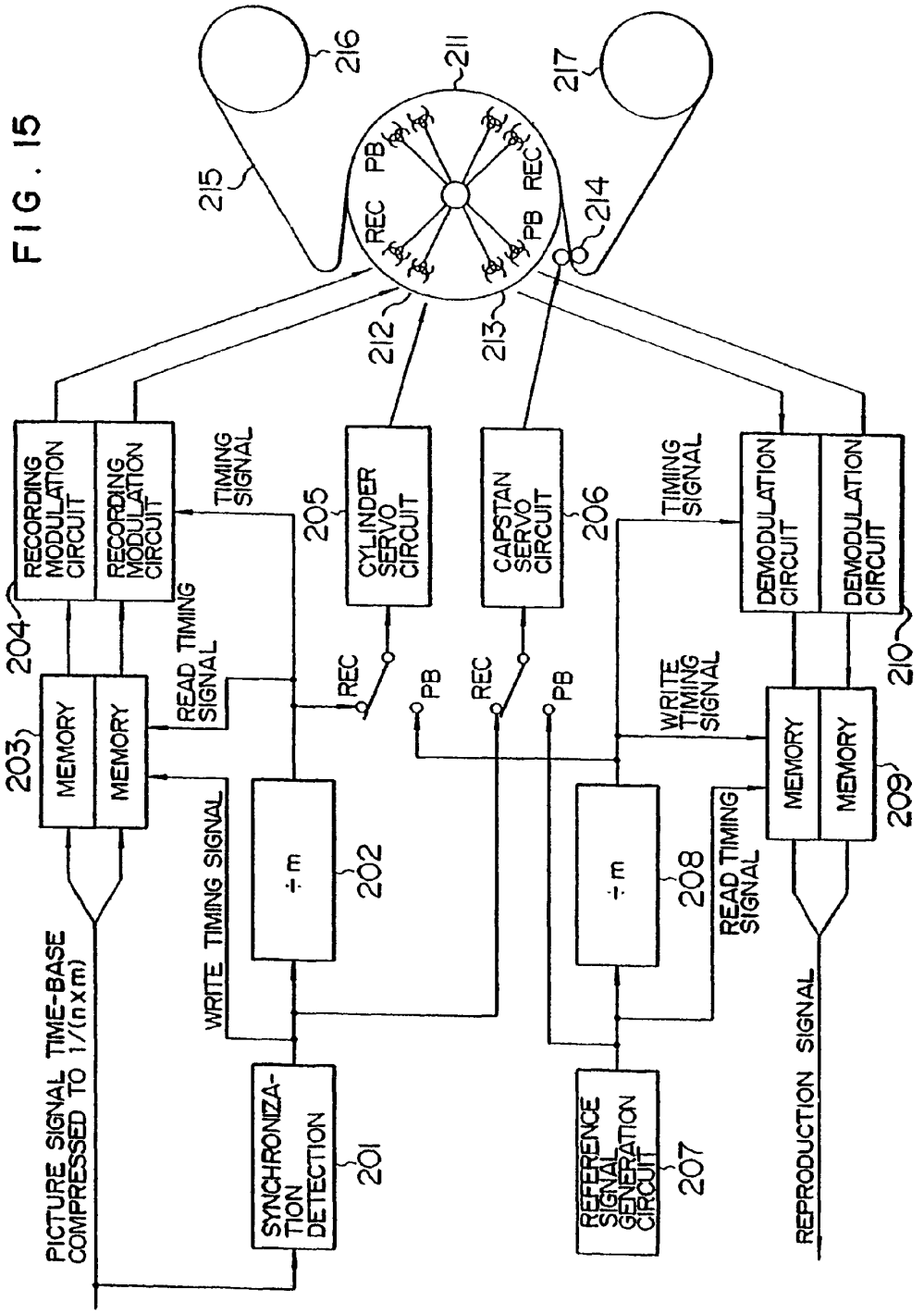

216
211
217
215
214
212
213
REC
PB
PB
REC
RECORDING MODULATION CIRCUIT
RECORDING MODULATION CIRCUIT
TIMING SIGNAL
CYLINDER SERVO CIRCUIT
CAPSTAN SERVO CIRCUIT
TIMING SIGNAL
DEMODULATION CIRCUIT
DEMODULATION CIRCUIT
204
205
206
210
READ TIMING SIGNAL
REC
PB
REC
PB
WRITE TIMING SIGNAL
MEMORY
MEMORY
MEMORY
MEMORY
203
209
WRITE TIMING SIGNAL
÷ m
202
÷ m
208
READ TIMING SIGNAL
PICTURE SIGNAL TIME-BASE COMPRESSED TO 1/(n x m)
SYNCHRONIZATION DETECTION
201
REFERENCE SIGNAL GENERATION CIRCUIT
207
REPRODUCTION SIGNAL

FIG. 16

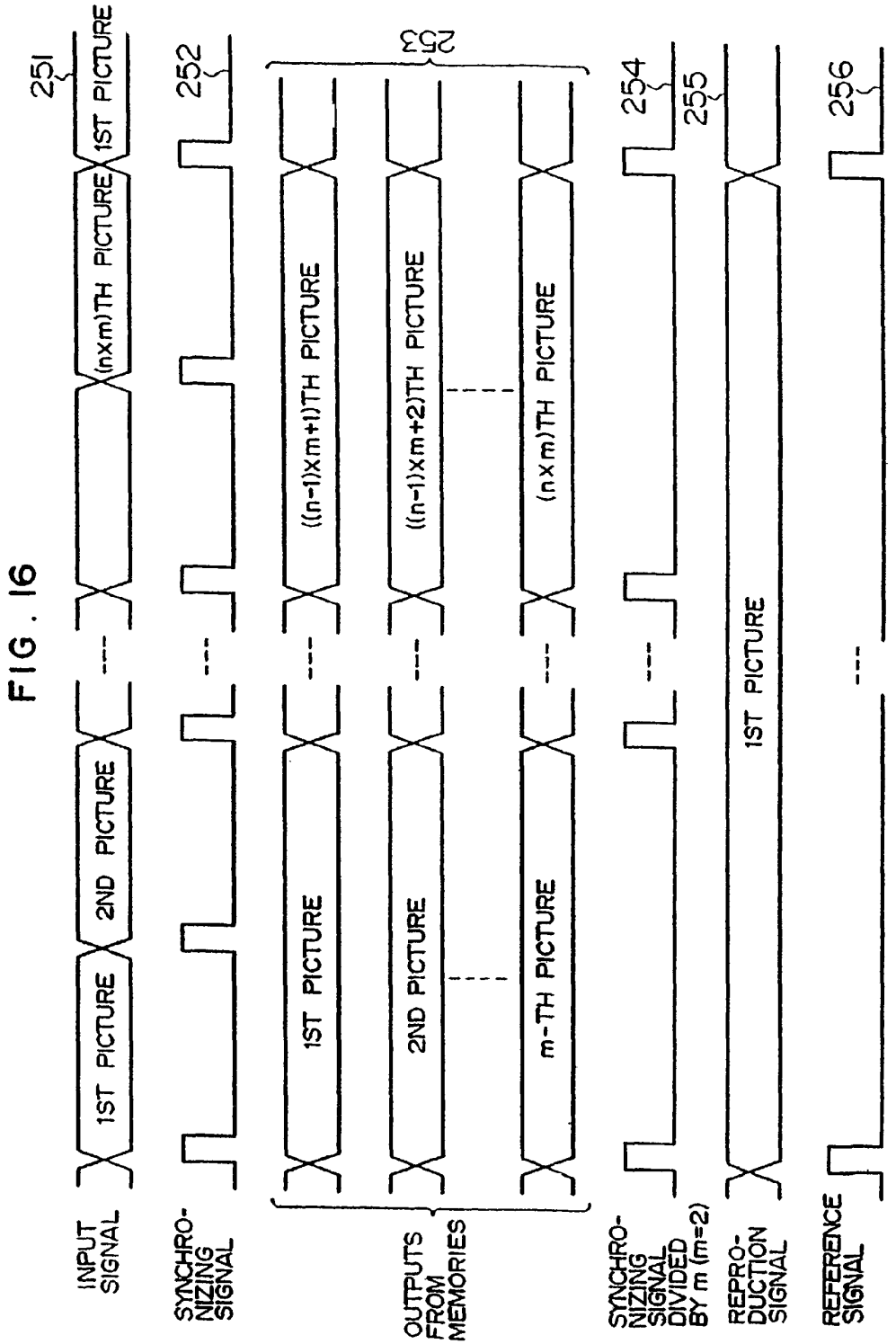
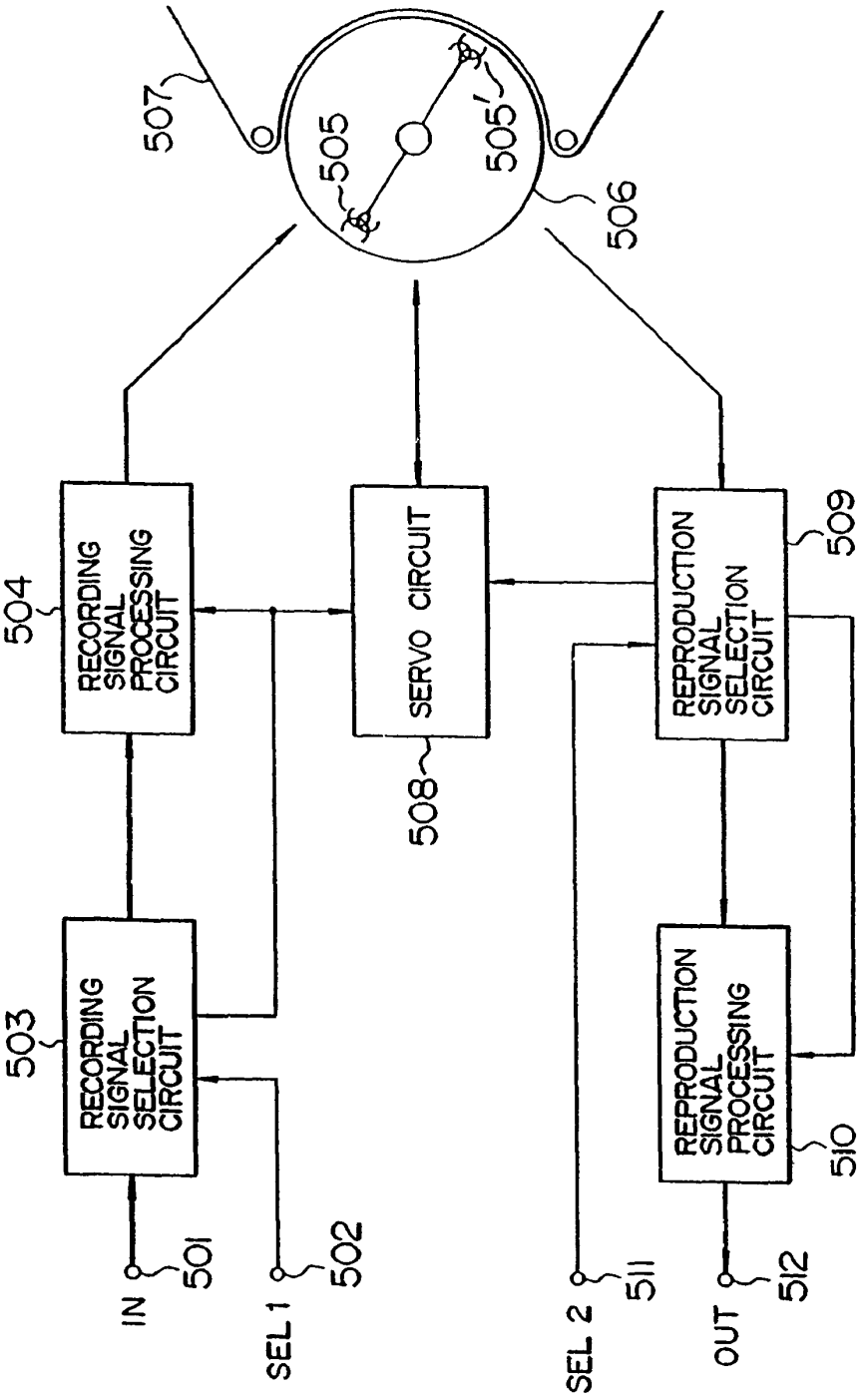

251
252
253
254
255
256
INPUT SIGNAL
SYNCHRO-NIZING SIGNAL
OUTPUTS FROM MEMORIES
SYNCHRO-NIZING SIGNAL DIVIDED BY m (m=2)
REPRO-DUCTION SIGNAL
REFERENCE SIGNAL
1ST PICTURE
2ND PICTURE
(nxm)TH PICTURE
((n-1)xm+1)TH PICTURE
((n-1)xm+2)TH PICTURE
m-TH PICTURE

FIG. 17

SYSTEM	MODE		TAPE SPEED (RATIO TO STANDARD SPEED)		CYLINDER ROTATION SPEED (rpm)		NUMBER OF HEAD PAIRS		CYLINDER DIAMETER (mmφ)	CYLINDER CONTACT ANGLE (deg)	NUMBER OF TRACKS REQUIRED FOR ONE PICTURE	REMARKS
	REC	PB	REC	PB	REC	PB	REC	PB				
VHS (NTSC)	NORMAL SPEED	NORMAL SPEED	1	1	1800	1800	1	1	62	180	1	
D2 (NTSC)	NORMAL SPEED	NORMAL SPEED	1	1	5400	5400	2	2	96	180	6	
EXAMPLE ①	HIGH SPEED	NORMAL SPEED	10	1	9000	900	1	1	120	180	1/2	
	HIGH SPEED	HIGH SPEED	10	10	9000	9000						
	NORMAL SPEED	HIGH SPEED	1	10	900	9000						
EXAMPLE ②	HIGH SPEED	NORMAL SPEED	10	1	9000	900	1	1	90	270	1/2	
	HIGH SPEED	HIGH SPEED	10	10	9000	9000						
	NORMAL SPEED	HIGH SPEED	1	10	900	9000						
EXAMPLE ③	HIGH SPEED	NORMAL SPEED	10	1	18000	1800	1	1	60	180	1	
	HIGH SPEED	HIGH SPEED	10	10	18000	18000						
	NORMAL SPEED	HIGH SPEED	1	10	1800	18000						
EXAMPLE ④	HIGH SPEED	NORMAL SPEED	10	1	9000	900	2	2	60	180	1	
	HIGH SPEED	HIGH SPEED	10	10	9000	9000						
	NORMAL SPEED	HIGH SPEED	1	10	900	9000						
EXAMPLE ⑤	HIGH SPEED	NORMAL SPEED	10	1	9000	1800	2	1	60	180	1	MOVABLE HEADS ARE REQUIRED
	HIGH SPEED	HIGH SPEED	10	10	9000	9000	2	2				
	NORMAL SPEED	HIGH SPEED	1	10	1800	9000	1	2				

FIG. 18


507
505
505'
506
504
RECORDING SIGNAL PROCESSING CIRCUIT
SERVO CIRCUIT
508
509
REPRODUCTION SIGNAL SELECTION CIRCUIT
503
RECORDING SIGNAL SELECTION CIRCUIT
REPRODUCTION SIGNAL PROCESSING CIRCUIT
510
IN
501
SEL 1
502
SEL 2
511
OUT
512

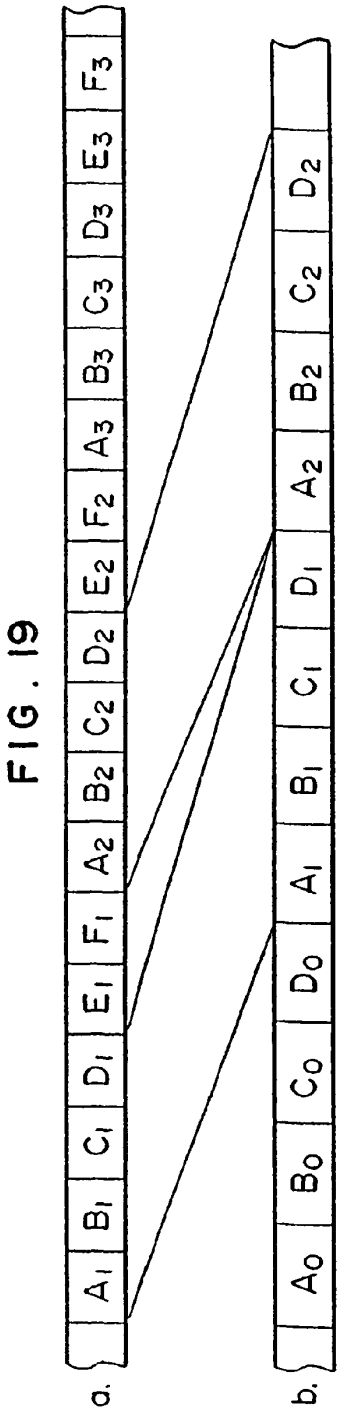

a.
b.
A1 B1 C1 D1 E1 F1 A2 B2 C2 D2 E2 F2 A3 B3 C3 D3 E3 F3
A0 B0 C0 D0 A1 B1 C1 D1 A2 B2 C2 D2

FIG. 19

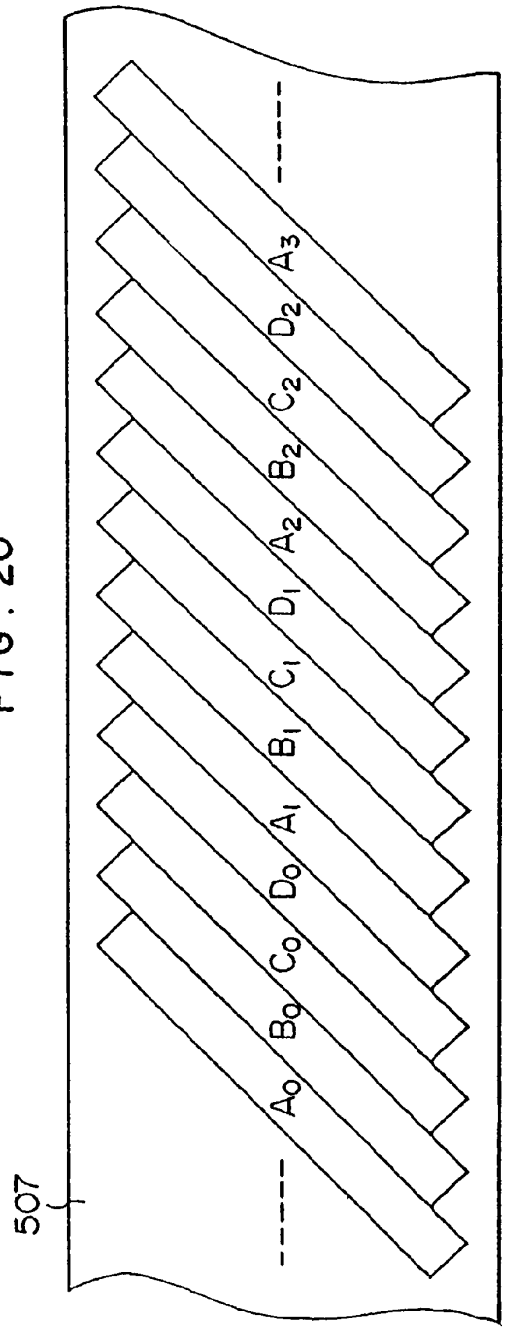

507
A0 B0 C0 D0 A1 B1 C1 D1 A2 B2 C2 D2 A3

FIG. 20

APPARATUS AND METHOD FOR RECEIVING AND RECORDING DIGITAL INFORMATION

CROSS REFERENCE TO RELATED APPLICATIONS

This is a continuation of U.S. application Ser. No. 10/404,452, filed Apr. 2, 2003, now U.S. Pat. No. 7,012,769, which is a continuation application of U.S. application Ser. No. 10/277,830, filed Oct. 23, 2002, now U.S. Pat. No. 6,590,726, which is a continuation of U.S. Ser. No. 09/809,047, filed Mar. 16, 2001, now U.S. Pat. No. 6,498,691, which is a continuation application of U.S. application Ser. No. 09/654,962, filed Sep. 5, 2000, now U.S. Pat. No. 6,324,025, which is a continuation of U.S. Ser. No. 09/567,005, filed May 9, 2000, now U.S. Pat. No. 6,278,564, which is a continuation application of U.S. Ser. No. 09/326,595, filed Jun. 7, 1999, now U.S. Pat. No. 6,069,757, which is a continuation of U.S. application Ser. No. 09/188,303, filed Nov. 10, 1998, now U.S. Pat. No. 6,002,536, which is a continuation of U.S. application Ser. No. 08/917,176, filed Aug. 25, 1997, now U.S. Pat. No. 5,862,004, which is a continuation of U.S. application Ser. No. 08/620,879, filed Mar. 22, 1996, now U.S. Pat. No. 5,699,203, and with U.S. application Ser. No. 08/620,880, filed Mar. 22, 1996, now U.S. Pat. No. 5,673,154, which are continuations of U.S. application Ser. No. 08/457,597, filed Jun. 1, 1995, now U.S. Pat. No. 5,530,598, which is a continuation of U.S. application Ser. No. 08/457,486, filed Jun. 1, 1995, now U.S. Pat. No. 5,517,368, which is a continuation of U.S. application Ser. No. 08/238,528, filed May 5, 1994, now U.S. Pat. No. 5,671,095, which is a divisional of U.S. application Ser. No. 07/727,059, filed Jul. 8, 1991, now U.S. Pat. No. 5,337,199, the subject matter of which are incorporated by reference herein.

BACKGROUND OF THE INVENTION

The present invention relates to a system for transmitting a digital video signal and recording the received video signal. More particularly, the present invention relates to great extension of the range of use of a digital signal recording/reproducing system by greatly shortening a recording time through transmission of a video signal in a compressed form, and further relates to great extension of the range of use of a digital signal recording/reproducing system by making the number of signals to be recorded and a recording/reproducing time variable.

As a digital magnetic recording/reproducing system (hereinafter referred to as VTR) is conventionally known, for example, a D2 format VTR. In such a conventional digital VTR, the elongation or shortening of a reproducing time is possible by using variable-speed reproduction. However, the prior art reference does not at all disclose high-speed recording in which a recording time is shortened to 1/m, multiple recording in which a plurality of signals are recorded, and the compression/expansion of a recording/reproducing time.

The above-mentioned conventional digital VTR has a feature that a high quality is attained and there is no deterioration caused by dubbing. However, the shortening of a dubbing time is not taken into consideration. Therefore, for example, in the case where a two-hour program is to be recorded, two hours are required. Thus, there is a drawback that inconveniences are encountered in use. Also, the multiplexing of recording signals is not taken into consideration. Therefore, for example, when two kinds of programs are to be simultaneously recorded or reproduced, two VTR's are required. This also causes inconveniences in use.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a digital VTR in which high-speed recording onto a tape can be made with the same format as that used in standard-speed recording, to provide a transmission signal processing system for transmitting at a high speed a video signal to be recorded by such a digital VTR, and to extend the range of use of the digital VTR by shortening a recording time. For example, the digital VTR can be used in such a manner that a two-hour program is recorded in about ten minutes and is reproduced at a standard speed.

The above object is achieved as follows. A video signal and an audio signal are subjected to time-base compression to 1/m, bit compression to 1/n, addition of a parity signal and modulation, and are thereafter transmitted or outputted. The transmitted signal is received, is subjected to demodulation, error correction, addition of a parity signal and modulation, and is thereafter recorded, onto a magnetic tape which travels at a travel speed m times as high as that upon normal reproduction, by use of a magnetic head on a cylinder which rotates at a frequency m times as high as that upon normal reproduction. The signal on the magnetic tape traveling at a travel speed upon normal reproduction is reproduced by a magnetic head on the cylinder which rotates at a frequency upon normal reproduction. The reproduced signal is subjected to demodulation, error correction, bit expansion of video and audio signals and D/A conversion, and is thereafter outputted. Address signals corresponding to a plurality of VTR's may be transmitted prior to a signal to be recorded. Further, control signals indicative of the start of recording and the stop of recording may be transmitted. The transmitted signals are received and error-corrected, and controls of the standby for recording, the start of recording and the stop of recording are made on the basis of the control signals.

With the above construction, since the video signal and the audio signal are time-base compressed to 1/m and bit-compressed to 1/n, a transmission time is shortened to 1/m and a signal band turns to m/n. The time-base compressed and bit-compressed signal is transmitted after addition of a parity signal for error correction and modulation to a code adapted for a transmission path. The transmitted signal is received and demodulated. The detection of an error produced in a transmitting system and the correction for the error can be made using the added parity signal. The error-corrected signal is added with a parity signal for correction for an error produced in a magnetic recording/reproducing system and is modulated to a code adapted for the magnetic recording/reproducing system. Upon recording, since the rotation frequency of the cylinder and the travel speed of the magnetic tape are increased by m times, the recording onto the magnetic tape can be made at an m-tuple speed. Upon reproduction, by setting the rotation frequency of the cylinder and the travel speed of the magnetic tape to normal ones, the reproduction at a normal speed can be made. The reproduced signal is code-demodulated. The detection of an error produced in the magnetic recording/reproducing system and the correction for the error can be made on the basis of the parity signal. By bit-expanding the video signal and the audio signal compressed by the transmission signal processing system, the original video and audio signal can be restored. The bit-expanded signal is converted into an analog signal by a D/A converter. Simultaneous and selective control of the start/stop of recording for a multiplicity of VTR's can be made in such a manner

that the address signals corresponding to the VTR's are transmitted prior to a signal to be recorded, the correction for an error of the received signal is made, required VTR's are brought into recording standby conditions by the corrected address signals, and the controls of the start of recording and the stop of recording are made by the transmitted control signals.

Another object of the present invention is to provide a digital signal recording/reproducing system in which multiple recording onto a tape can be made with the same format as that used in standard recording and simultaneous multiple reproduction is possible, and to extend the range of use of a digital VTR by compressing/expanding a recording/reproducing time in accordance with the transmission rate of a multiplexed input/output signal and the number of signals in the multiplexed input/output signal.

This object is achieved as follows. There are provided means for selecting one or plural desired signals from a time-base compressed and time-division multiplexed digital input signal, and helical scan recording means for making time-division multiplex recording of the selected signals with a time-base compressed speed after selection being retained. There is further provided means for reproducing the recorded signals with the rotation speed of a cylinder, a tape speed and so on being set to values proportional to the transmission rate of a reproduction signal and the number of signals to be simultaneously reproduced and with the signal being time-base expanded or being retained as time-base compressed.

With the above construction, N kinds of desired signals selected from the multiplexed input digital signal and time-base compressed to 1/K are subjected to time-division multiplex recording with a time-base compressed speed after selection being retained. Upon reproduction, for example, if both the cylinder rotation speed and the tape speed are set to N/K times, a recording track and a reproducing track coincide with each other and the use of a reproducing time K/N times as long as a recording time enables the reproduction of each of the N kinds of signals at a standard speed. Also, if both the cylinder rotation speed and the tape speed are set to (M×N)/K times, a recording track and a reproducing track coincide with each other and the use of a reproducing time as K/(M×N) times as long as the recording time enables the reproduction of each of the N kinds of signals at an M-tuple speed. In the case where L kinds of signals are selected from among the N kinds of reproduced signals and a processing speed at a reproduction signal processing circuit is set to L×M times as long as a standard reproduction processing speed, each of the L kinds of signals among the N kinds of multiple-recorded signals is outputted at a speed M times as high as a standard speed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a digital transmission signal processing system and a recording/reproducing system according to an embodiment of the present invention;

FIG. **2** is a block diagram of a recording/reproducing system according to another embodiment of the present invention;

FIG. **3** is a diagram for explaining the conventional parity adding method;

FIG. **4** is a block diagram of a recording/reproducing system according to still another embodiment of the present invention;

FIG. **5** is a block diagram of a digital transmission signal processing system and a recording/reproducing system according to a further embodiment of the present invention;

FIG. **6** shows the format of control signals used in one of applications of the present invention;

FIG. **7** is a block diagram of a still further embodiment of the present invention;

FIG. **8** shows one example of the specification of signals to be recorded;

FIG. **9** is a block diagram of a furthermore embodiment of the present invention;

FIGS. **10**, **11** and **12** are block diagrams of different examples of applications of the present invention;

FIG. **13** is a block diagram for explaining one example of the operation of the embodiment shown in FIG. **7**;

FIG. **14** is a timing chart showing the waveforms of signals involved in the example shown in FIG. **13**;

FIG. **15** is a block diagram for explaining another example of the operation of the embodiment shown in FIG. **7**;

FIG. **16** is a timing chart showing the waveforms of signals involved in the example shown in FIG. **15**;

FIG. **17** is a table showing some applications of the examples shown in FIGS. **13** and **15**;

FIG. **18** is a block diagram of a still furthermore embodiment of the present invention; and

FIGS. **19** and **20** are signal diagrams for explaining different operations of the embodiment shown in FIG. **18**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the present invention will now be explained by use of FIG. **1**. In the figure, reference numerals **1** and **40** denote magnetic tapes, numerals **2**, **3**, **41** and **42** magnetic heads, numerals **4** and **43** cylinders, numerals **5** and **44** capstans, numerals **10** and **50** servo control circuits, numerals **20**, **31** and **60** demodulation circuits, numerals **21**, **32** and **61** error correction circuits, numerals **22** and **23** compression circuits, numerals **24** and **33** parity addition circuits, numerals **25** and **34** modulation circuits, numerals **26** a transmission circuit, numeral **27** a transmission path, numeral **30** a reception circuit, numerals **62** and **63** expansion circuits, numerals **64** and **65** D/A conversion circuits, numeral **70** a video signal output terminal, and numeral **71** an audio signal output terminal.

Firstly, the operation of a transmission signal processing system will be explained. Digital video and audio signals recorded on the magnetic tape **1** are reproduced by the magnetic heads **2** and **3** mounted on the cylinder **4** and are inputted to the demodulation circuit **20**. The magnetic tape **1** travels by virtue of the capstan **5**. The travel speed of the magnetic tape **1** and the rotation frequency of the cylinder **4** are, for example, ten times as high as the tape travel speed and the cylinder rotation speed upon normal reproduction. Accordingly, the signal inputted to the demodulation circuit **20** is a signal time-compressed to one tenth. For example, a 120-minute signal recorded on the magnetic tape **1** can be reproduced in 12 minutes.

Generally, in the case where a digital signal is to be recorded on a magnetic recording medium, the signal is recorded after having been modulated into scrambled NRZ code, M^2 code or the like. The demodulation circuit **20** performs a demodulation processing, that is, a signal processing for restoring the thus modulated signal into original digital data. The signal demodulated by the demodulation circuit **20** is inputted to the error correction circuit **21** in which erroneous data produced in a magnetic recording/reproducing process is detected and the correction for the erroneous data is made. Further, the signal is separated into a video signal and an audio signal which are in turn inputted to the compression

circuits **22** and **23**, respectively. The video signal is bit-compressed through, for example, discrete cosine conversion. The audio signal is bit-compressed through, for example, non-linear quantization or differential PCM. As a result, the transmission rate of the video signal and the audio signal in total is reduced to, for example, one twentieth.

Output signals of the compression circuits **22** and **23** are inputted to the parity addition circuit **24** for performing a signal processing which includes adding a parity signal for error correction and outputting the video signal and the audio signal serially in accordance with a transmission format. A serial output signal of the parity addition circuit **24** is inputted to the modulation circuit **25**. In the modulation circuit **25**, the serial signal is modulated in accordance with the characteristic and the frequency band of the transmission path **27**. For example, in the case where the signal is transmitted in an electric wave form, quadruple phase shift keying (QPSK) is made. The modulated signal is inputted to the transmission circuit **26** from which it is outputted to the transmission path **27**.

As apparent from the foregoing explanation of the operation of the transmission signal processing system, it is possible to transmit a signal at a speed which is ten times as high as a normal speed.

The above embodiment has been shown in conjunction with the case where a signal from the VTR is reproduced. However, a signal source is not limited to the VTR and may include a magnetic disk device, an optical disk device or the like.

Next, explanation will be made of the operation of the VTR for receiving and recording the transmitted signal. The signal transmitted from the transmission signal processing system is received by the reception circuit **30**. The received signal is inputted to the demodulation circuit **31**. The demodulation circuit **31** is provided corresponding to the modulation and demodulates the signal to the original signal. The demodulated signal is inputted to the error correction circuit **32** in which the detection of and the correction for an error produced in the transmission path **27** are made on the basis of the parity signal added by the parity addition circuit **24**. At this time, in the case where the S/N ratio of the transmission system is not sufficient so that complete correction for the error is impossible, correction is made through, for example, signal replacement, by use of the signal correlation.

An output signal of the error correction circuit **32** is inputted to the parity addition circuit **33**. In the parity addition circuit **33**, a parity signal for detecting an error produced in a recording/reproducing process and making correction for the error is added. The parity-added signal is inputted to the modulation circuit **34**. In the modulation circuit **34**, the signal is modulated to scrambled NRZ code, M^2 code or the like as mentioned above. The modulated signal is recorded on the magnetic tape **40** by the magnetic heads **41** and **42** mounted on the cylinder **43**.

Since the signal supplied to the magnetic heads **41** and **42** is a signal which is time-base compressed to one tenth as compared with a signal upon normal operation, the servo control circuit **50** controls the cylinder **43** and the capstan **44** so that the rotation frequency of the cylinder **43** and the travel speed of the magnetic tape **40** become ten times as high as those upon normal recording. Also, in order to record a predetermined signal at a predetermined position on the magnetic, tape **40**, synchronization information is detected from the received signal to control the phase of rotation of the cylinder **41** on the basis of the detected synchronization information.

Next, the operation of the VTR for reproducing the thus recorded signal will be explained. Upon reproduction, the travel speed of the magnetic tape **40** and the rotation frequency of the cylinder **43** are set to those upon normal reproduction. The reproduced signal is inputted to the demodulation circuit **60**. The demodulation circuit **60** is provided corresponding to the modulation circuit **34** and demodulates the modulated signal. The demodulated signal is inputted to the error correction circuit **61** in which the detection of an error produced in the magnetic recording/reproducing system and the correction for the error are made on the basis of the parity signal added by the parity addition circuit **33**. In the case where there is an error which cannot be corrected, the error is properly corrected by use of the signal correlation. Also, the signal is outputted after having been separated into a video signal and an audio signal.

The video signal is inputted to the expansion circuit **62**. The expansion circuit **62** is provided corresponding to the compression circuit **22** and restores the compressed video signal into the original video signal. An output signal of the expansion circuit **62** is inputted to the D/A conversion circuit **64** and is converted thereby into an analog video signal which is in turn outputted from the terminal **70**.

The audio signal is inputted to the expansion circuit **63**. The expansion circuit **63** is provided corresponding to the compression circuit **23** and restores the compressed audio signal into the original audio signal. An output signal of the expansion circuit **63** is inputted to the D/A conversion circuit **65** and is converted thereby into an analog audio signal which is in turn outputted from the terminal **71**.

In the foregoing, the embodiment of the present invention has been shown and the operation thereof has been explained. According to the present invention, a video signal and an audio signal over a long time can be transmitted and recorded in a short time, thereby making it possible to extend the range of use of the digital VTR.

Another embodiment of the present invention is shown in FIG. **2**. FIG. **2** is partially similar to FIG. **1**. The same parts in FIG. **2** as those in FIG. **1** are denoted by the same reference numerals as those used in FIG. **1** and detailed explanation thereof will be omitted. The embodiment shown in FIG. **2** concerns a VTR in which a signal transmitted/received at a high speed can be recorded while being monitored.

In FIG. **2**, reference numeral **80** denotes a change-over switch, numeral **81** an error correction circuit, and numeral **82** a memory circuit. An error corrected video signal outputted from the error correction circuit **81** is inputted through the memory circuit **82** to a terminal R side of the change over switch **80** which is selected upon recording. The memory circuit **82** has a memory capacity for at least one field. The video signal received at a high speed is stored into a memory of the memory circuit **82** with the number of frames being reduced. The stored signal is read from the memory at a normal speed and is inputted to an expansion circuit **62**.

Upon reproduction, a video signal output of an error correction circuit **61** is inputted to a terminal P side of the change-over switch **80** which is selected upon reproduction. Accordingly, the operation of the embodiment of FIG. **2** upon reproduction is similar to that of the embodiment shown in FIG. **1**.

In the embodiment shown in FIG. **2**, upon recording, the video signal outputted from the error correction circuit **81** is inputted to the expansion circuit **62** through the memory circuit **82**. Alternatively, an output signal of a modulation circuit **34** may be inputted to a demodulation circuit **60** through a memory circuit. Also, in the case where the operating speed of the demodulation circuit **60** or the error cor-

rection circuit **61** leaves a margin, a memory circuit may be properly placed at a post stage. Or, in the case where the storage capacity of the error correction circuit **61** or the expansion circuit **62** leaves a margin, the circuit may be used as a memory circuit or any additional memory circuit may be omitted.

As has been explained in the above, the embodiment shown in FIG. **2** makes it possible to record a received video signal while monitoring it in the form of a picture having a reduced number of frames.

In the embodiment shown in FIG. **1**, the parity signal is added in order to make the detection of and the correction for an error which may be produced in the transmission system or the magnetic recording/reproducing system. One example of a parity adding method is shown in FIG. **3** in conjunction with the case of a D2 format VTR. In the D2 format VTR, a signal for one field is divided into a plurality of segments for signal processing. FIG. **3** shows one segment. In FIG. **3**, reference numeral **90** represents a group of video data, numeral **91** a group of outer code parities, and numeral **92** a group of inner code parities. Firstly, outer code parities are added for data of the matrix-like arranged video data group **90** which lie in a vertical direction in FIG. **3**. Thereafter, inner code parities are added for data of the video data group **90** and the outer code parity group **91** lying in a horizontal direction in FIG. **3**, thereby producing a signal to be recorded. Though detailed explanation of the generation of parities will be omitted herein, the parities are generated in accordance with a generating function G(x).

In the embodiment shown in FIG. **1**, if the same parity generation manner is employed by the parity addition circuits **24** and **33**, the error correction circuits **32** and **61** may hold the most part thereof in common. Namely, since the error correction circuits **32** and **61** are circuits which are respectively used upon recording and upon reproduction, it is possible to reduce the circuit scale or size by using the most part of the circuits **32** and **61** in common.

Further, in the case where the same parity generation manner is employed by the parity addition circuits **24** and **33** in the embodiment shown in FIG. **1**, it is possible to further reduce the circuit scale or-size of the recording/reproducing system. The construction in that case is shown in FIG. **4** as still another embodiment of the present invention. FIG. **4** is partially common to FIG. **1** or **2**. The parts in FIG. **4** common to those in FIG. **1** or **2** are denoted by the same reference numerals as those used in FIG. **1** or **2** and detailed explanation thereof will be omitted.

The embodiment shown in FIG. **4** is based on a concept that an error produced in a transmission system and an error produced in a magnetic recording/reproducing system are simultaneously detected and corrected by an error correction circuit **61**. Accordingly, a signal received by a reception circuit **30** is demodulated by a demodulation circuit **31** and is inputted to a modulation circuit **34** without being subjected to error correction and parity addition. The subsequent processing is the same as that in the embodiment shown in FIG. **1** or **2**. Namely, a reproduced signal is inputted to the error correction circuit **61** after demodulation by a demodulation circuit **60**. As mentioned above, an error produced in the transmission system and an error produced in the magnetic recording/reproducing system are simultaneously detected and corrected by the error correction circuit **61** in the reproducing system.

In the embodiment shown in FIG. **4**, the error correction circuit **32** and the parity addition circuit **33** can be removed as compared with the embodiment shown in FIG. **1** or **2**, thereby making it possible to reduce the circuit scale.

Though having not been mentioned in the foregoing embodiments, in a helical scan VTR as shown, since a signal becomes discontinuous when a track jump is made upon reproduction, the recording is made with an amble signal being added to the heading portion of a signal. Since the addition of an amble signal is employed in the D2 format VTR, detailed explanation thereof will be omitted. Also, in order to define a starting position of a signal, a synchronizing signal is properly added. Since the addition of a synchronizing signal is known in, for example, the D2 format VTR, detailed explanation thereof will be omitted.

In the embodiment shown in FIG. **1**, the addition of an amble signal may be made by the parity addition circuit **24**. Alternatively, it may be made on the recording/reproducing system side in order to enhance the efficiency of use of the transmission path **27**. In this case, the addition of an amble signal can be made by the parity addition circuit **33**. As for the embodiment shown in FIG. **4**, in the case where the addition of an amble signal is to be made on the recording/reproducing system side, the amble signal can be added by the modulation circuit **34**. In the case where the addition of an amble signal is made on the recording/reproducing system side, it is possible to enhance the efficiency of use of the transmission path **27**. On the other hand, in the case where the addition of an amble signal is made on the transmission signal processing system side, the lowering of the cost of a VTR can be attained as a great effect when a signal is sent to a multiplicity of VTR's simultaneously.

FIG. **5** shows a further embodiment of the present invention in which the further reduction of the circuit scale of a VTR on the receiving side and hence the further lowering of the cost can be attained in the case where a signal is sent to a multiplicity of VTR's simultaneously.

FIG. **5** is partially common to FIG. **1**, **2** or **4**. The parts in FIG. **5** common to those in FIG. **1**, **2** or **4** are denoted by the same reference numerals as those used in FIG. **1**, **2** or **4** and detailed explanation thereof will be omitted. In FIG. **5**, reference numeral **100** denotes a modulation circuit. The embodiment shown in FIG. **5** is based on a concept that a signal processing required upon a recording mode of a VTR is performed on the transmitting side. Namely, modulation adapted for magnetic recording/reproduction, for example, a signal processing corresponding to the modulation circuit **34** shown in FIG. **4** is performed on the transmission signal processing system side. After parities have been added by a parity addition circuit **24** of the transmission signal processing system, the modulation adapted for the magnetic recording/reproduction is performed by the modulation circuit **100**. Therefore, modulation adapted for transmission is performed by a modulation circuit **25**. As a modulation system employed by the modulation circuit **100** is suitable a system which does not cause the extension of a frequency band by modulation, for example, scrambled NRZ. A signal modulated by the modulation circuit **25** is transmitted to a transmission path **27** through a transmission circuit **26** in a manner to that in the embodiment shown in FIG. **1**.

The signal received by a reception circuit **30** through the transmission path **27** is inputted to a demodulation circuit **31** in which the signal is subjected to demodulation corresponding to the modulation circuit **25**. Since the signal demodulated by the demodulation circuit **31** is one which has already been subjected by the modulation circuit **10** to the modulation adapted for the magnetic recording/reproduction, the signal is recorded on a magnetic tape **40** by magnetic heads **41** and **42** as it is. As a result, the same recording as that in the embodiment shown in FIG. **4** is made. An operation upon reproduction is similar to that in the embodiment shown in FIG. **4**.

As apparent from the above, the present embodiment makes it possible to remarkably reduce the circuit scale of the VTR.

According to one of applications of the present invention, it is possible to transmit a signal from a transmission signal processing system to a multiplicity of VTR's through a transmission path simultaneously and at a high speed, as has already been mentioned. In this case, it is difficult to control a multiplicity of 'VTR's simultaneously. Further, it is required to make a control which causes specified ones of the VTR's to perform recording operations and specified others of the VTR's not to perform recording operations. A technique for realizing such a control will be shown just below.

For the above purpose, control signals are transmitted prior to transmission of a signal to be recorded. One example of the control signals is shown in FIG. **6**. In the figure, reference numeral **110** denotes a synchronizing signal, numeral **111** an ID signal indicative of a control to be made, numeral **112** an address signal indicative of a VTR to be controlled, numeral **113** a control signal for bringing a VTR designated by the address signal **112** into a recording mode, numeral **114** a control signal for stopping the recording, numerals **115** and **116** blank signals, and numeral **120** a recording signal to be actually recorded.

The ID signal **111** indicating the transmission of the address signals **112** indicative of VTR's in which a signal is to be recorded, is transmitted at a predetermined position relative to the synchronizing signal **110** to bring each VTR into a standby condition. After all the address signals have been transmitted, the ID signal **113** is transmitted to start the recording of the signal **120** in the designated VTR's. After the signal **120** has been transmitted, the ID signal **114** to control the stop of recording is transmitted. Each of the blank signals **115** and **116** is a signal for conforming a signal transmission format to the other transmission signal and is therefore an insignificant signal portion.

In the embodiments shown in FIGS. **1** and **5**, those control signals are produced by a control signal generation circuit **130** and are transmitted with parities which are added by the parity addition circuit **24** for making correction for an error produced during transmission.

In the VTR shown in FIG. **1**, the control signals are detected by a control circuit **131** after the reception by the reception circuit **30**, the demodulation by the demodulation circuit **31** and the correction by the error correction circuit **32** for an error produced during transmission to make a control for the recording and the stop of recording in the recording/reproducing system.

In the case of the VTR's shown in FIGS. **4** and **5**, an output signal of the demodulation circuit **31** is inputted to the error correction circuit **61** for a need of making correction for an error produced during transmission and error-corrected control signals are inputted to a control circuit **131**. In a change-over circuit **132**, the terminal R side for selecting an output signal of the demodulation circuit **31** is selected upon recording and the terminal P side for selecting an output signal of the demodulation circuit **60** is selected upon reproduction.

As apparent from the foregoing, the present embodiment makes it possible to control a multiplicity of VTR's selectively and simultaneously.

Also, the use of the change-over circuit **132** and a memory circuit makes it possible to record a signal while monitoring it in the form of a picture having a reduced number of frames, as explained in conjunction with the embodiment shown in FIG. **2**.

Next, a still further embodiment of the present invention will be explained by use of FIG. **7**. In the figure, reference numeral **301** denotes an input terminal for standard analog video signal, numeral **302** an input terminal for standard digital video signal, numeral **303** an input terminal for high-speed digital video signal, numeral **305** a recording system mode change-over switch, numeral **306** a recording system change-over signal generation circuit, numeral **310** an A/D converter, numeral **320** a change-over circuit, numeral **330** a data compression circuit, numeral **340** a change-over circuit, numeral **350** a recording system signal processing circuit for performing a signal processing which includes addition of error correction code and modulation for recording, numeral **370** a cylinder, numeral **371** a magnetic tape, numerals **372** and **372'** magnetic heads, numeral **380** a reproducing system signal processing circuit for performing a signal processing which includes demodulation for reproduction, error detection and error correction. Numeral **390** a change-over circuit, numeral **400** a data expansion circuit, numeral **420** a D/A converter, numeral **431** an output terminal for standard analog video signal, numeral **432** an output terminal for standard digital video signal, numeral **433** an output terminal for high-speed digital video signal, numeral **435** a reproducing system mode change-over switch, and numeral **436** a reproducing system change-over signal generation circuit.

The present embodiment is an example of a digital magnetic recording/reproducing system which has recording modes of standard-speed recording and high-speed recording and reproduction modes of standard-speed reproduction and high-speed reproduction. FIG. **8** shows one example of the specification of input video signals.

Firstly, explanation will be made of standard-speed recording. A digital signal into which an analog video signal inputted from the input terminal **301** is converted by the A/D converter **310** or an equivalent digital signal which is inputted from the input terminal **302**, is switched or selected by the change-over circuit **320**, is subjected to a predetermined data compression processing by the data compression circuit **330** and is thereafter inputted to a terminal **340***a* of the changeover circuit **340**. In the change-over circuit **340**, a change-over to connect the terminal **340***a* and a terminal **340***c* is made by a change-over signal from the recording system change-over signal generation circuit **306**. Thereby, the data-compressed signal is inputted to the recording system signal processing circuit **350**. In the recording system signal processing circuit **350**, a signal processing such as channel division, addition of error correction code and modulation for recording is performed at a predetermined processing clock adapted for the data-compressed signal. Thereafter, the signal is supplied to the magnetic heads **372** and **372'** mounted on the cylinder **370** so that it is recorded onto the magnetic tape **371**. The cylinder **370** and the magnetic tape **371** are controlled by a servo control circuit **360**. The servo control circuit **360** controls a cylinder motor and a capstan motor so as to provide a cylinder rotation speed and a tape speed for standard speed and so as to be synchronized with the input video signal.

Next, explanation will be made of high-speed recording. A high-speed digital video signal inputted from the input terminal **303** is sent to a terminal **340***b* of the change-over circuit **340**. Since the high-speed digital video signal is a signal which has already been subjected to a data compression processing, it is not necessary to pass the signal through the data compression circuit **330**. A change-over to connect the terminal **340***b* and the terminal **340***c* is made by a change-over signal from the recording system change-over signal generation circuit **306** so that the high-speed digital video signal is inputted to the recording system signal processing circuit **350**. In the recording system signal processing circuit **350**, a signal processing similar to that in the case of the standard-

speed recording is performed at a predetermined processing clock adapted for the high-speed digital video signal. Thereafter, the signal is supplied to the magnetic heads **372** and **372'** mounted on the cylinder **370** so that it is recorded onto the magnetic tape **371**. The cylinder **370** and the magnetic tape **371** are controlled by the servo control circuit **360**. The servo control circuit **360** control the cylinder motor and the capstan motor so as to provide a predetermined cylinder rotation speed and a predetermined tape speed and so as to be synchronized with the input video signal.

In the present invention, the recording onto the tape can be made with the quite same format in both the standard-speed recording and the high-speed recording, thereby making it possible to greatly shorten a recording time in the high-speed recording mode.

Next, explanation will be made of a signal processing upon reproduction. In the present embodiment, the recording pattern on the magnetic tape is the same whichever of the standard-speed recording and the high-speed recording is selected as a recording mode. Therefore, either standard-speed reproduction or high-speed reproduction can be selected irrespective of the recording mode.

Firstly, the standard-speed reproduction will be explained. The servo control circuit **360** controls the cylinder motor and the capstan motor so that a cylinder rotation speed and a tape speed for standard speed are provided. A signal reproduced by the magnetic heads **372** and **372'** is inputted to the reproducing system signal processing circuit **380**. In the reproducing system signal processing circuit **380**, a signal processing such as demodulation for reproduction, channel synthesis, error detection and error correction is performed at a predetermined processing clock adapted for the standard-speed reproduction. Thereafter, the signal is supplied to a terminal **390***a* of the change-over circuit **390**. In the change-over circuit **390**, a changeover to connect the terminal **390***a* and a terminal **390***c* is made upon standard-speed reproduction by a change-over signal from the reproducing system change-over signal generation circuit **436**. Thereby, the reproduced signal is supplied to the data expansion circuit **400**. In the data expansion circuit **400**, a signal processing reverse to the data compression processing upon recording is performed so that the signal is restored to the original signal. Thereby, the original transmission rate is restored. The data-expanded reproduction signal is sent to the D/A converter **420** on one hand to be outputted as an analog video signal from the output terminal **431** after D/A conversion and is sent to the output terminal **432** on the other hand to be outputted as a digital video signal therefrom.

Next, explanation will be made of the high-speed reproduction. The servo control circuit **360** controls the cylinder motor and the capstan motor so that a predetermined cylinder rotation speed and a predetermined tape speed adapted for the high-speed reproduction are provided. A signal reproduced by the magnetic heads **372** and **372'** is inputted to the reproducing system signal processing circuit **380**. In the reproducing system signal processing circuit **380**, a signal processing such as demodulation for reproduction, channel synthesis, error detection and error correction is performed at a predetermined processing clocks adapted for the high-speed reproduction. Thereafter, the high-speed reproduction signal is supplied to the terminal **390***a* of the change-over circuit **390**. In the change-over circuit **390**, a change-over to connect the terminal **390***a* and a terminal **390***b* is made upon high-speed reproduction. Thereby, the high-speed digital video signal is outputted from the output terminal **433**.

A furthermore embodiment of the present invention will be explained by use of FIG. **9**. The construction of the present embodiment is similar to that of the embodiment shown in FIG. **7** but is different therefrom in that the change-over circuit **340** is placed at a different position, the change-over circuit **390** used in FIG. **7** is eliminated and a change-over circuit **345** is newly added.

An input/output signal upon standard-speed recording/reproduction in the present embodiment is the same as that in the embodiment shown in FIG. **7**. As for high-speed recording and high-speed reproduction, however, the present embodiment is different from the embodiment of FIG. **7** in that the transmission of a high-speed digital video signal is made in the form of a recording format. Accordingly, upon high-speed recording, the high-speed digital video signal is not passed through a recording system signal processing circuit **350** but is recorded onto a tape through the change-over circuit **340** as it is. Upon high-speed reproduction, a reproduced signal is subjected to a signal processing for reproduction such as error detection and error correction by a reproducing system signal processing circuit **380** and is thereafter inputted to a terminal **345***b* of the change-over circuit **345**. The signal supplied through the change-over circuit **345** to the recording system side signal processing circuit **350** is subjected to a signal processing for recording such as addition of error correction code and modulation for recording by the signal processing circuit **350** to form a recording format and is thereafter outputted as a high-speed digital video signal from an output terminal **433**.

The embodiments shown in FIGS. **7** and **9** have feature that high-speed recording and high-speed reproduction are possible. The best use of this feature can be made for dubbing or data communication with the result of effective shortening of a dubbing time, a data communication time or a data circuit line occupation time. Also, though those embodiments have been mentioned in conjunction with an example in which all of standard-speed recording, high-speed recording, standard-speed reproduction and high-speed reproduction modes are involved, it is not necessarily required to implement all of those modes. There may be considered an example in which only a necessary mode is provided in compliance with the purpose of use. FIG. **10** shows an embodiment in which a high-speed recording function is provided as a recording mode and at least a high-speed reproduction function is provided as a reproduction mode. Also, there may be considered an embodiment as a system for the exclusive use for reproduction in which at least a high-speed reproduction function is provided, as shown in FIG. **11**. Further, FIG. **12** shows an embodiment in which a high-speed recording function is provided as a recording mode and a standard-speed reproduction function is provided as a reproduction mode.

FIG. **13** is a block diagram of one example of the magnetic recording/reproducing system of the embodiment of FIG. **7** for explaining processings subsequent to the compression processing. In FIG. **13**, reference numeral **201** denotes a synchronization detection circuit, numeral **204** a recording modulation circuit, numeral **205** a cylinder servo control circuit, numeral **206** a capstan servo (or tape speed) control circuit, numeral **207** a reproduction reference signal generation circuit, numeral **210** a demodulation circuit, numeral **211** a cylinder, numeral **212** a pair of recording heads, numeral **213** a pair of reproducing heads, numeral **214** a capstan which controls the tape speed, numeral **215** a magnetic tape, numeral **216** a delivery reel, and numeral **217** a take-up reel. FIG. **14** is a timing chart of input and output signals in the example shown in FIG. **13** and schematically illustrate a compressed picture signal **251** which is an input signal, a synchronizing signal **252** of the picture signal, a standard-

speed reproduction signal **255** which is an output signal, and a reproduction synchronizing signal **256**.

In the shown example, n-tuple speed recording is realized by making a tape speed and a cylinder rotation speed upon recording n times as high as those upon standard-speed reproduction. As shown in FIG. **14**, the compressed video signal as an input signal of the circuit shown in FIG. **13** and the synchronizing signal include information **251** for n pictures and n synchronizing pulses **252** synchronous therewith in a time when one picture is reproduced at a standard speed. The picture information is converted into a predetermined recording format by the recording modulation circuit **204** and is recorded onto the magnetic tape **215** by the recording heads **212**. At this time, a synchronizing signal for the cylinder servo control circuit **205** and the capstan-servo control circuit **206** is increased by n times in compliance with the n-tuple speed video signal, as shown by **252** in FIG. **14**, so that the rotation speed of the cylinder **211** and the feed speed of the magnetic tape **215** are increased by n times. Thereby, the recording onto the tape can be made with the quite same recording format as that in the case of the standard-speed recording. Upon reproduction, a synchronizing signal for the cylinder servo control circuit **205** and the capstan servo control circuit **206** is supplied from the reproduction reference signal generation circuit **207** to restore the cylinder rotation speed and the tape feed speed to those upon standard-speed reproduction, and a signal read by the reproducing heads **213** is demodulated by the demodulation circuit **210** and is outputted therefrom. In the circuit shown in FIG. **13**, if the input video signal and the synchronizing signal are ones of standard speed, standard-speed recording is possible. Also, n-tuple speed reproduction is possible if the frequency of an output signal from the reproduction reference signal generation circuit is increased by n times.

FIG. **15** is a block diagram of another example of the magnetic recording/reproducing system of the embodiment of FIG. **7** for explaining processings subsequent to the compression processing. FIG. **16** is a timing chart of input and output signals in the example shown in FIG. **15**. In FIG. **15**, the same reference numerals as those used in FIG. **13** denote the same or equivalent components as or to those shown in FIG. **13**. In FIG. **15**, reference numeral **202** denotes a ÷m circuit, numeral **203** recording system memories, numeral **208** a ÷m circuit, and numeral **209** reproducing system memories. In FIG. **16**, the same reference numerals as those used in FIG. **14** denote the same or equivalent signals as or to those shown in FIG. **14**. In FIG. **16**, reference numeral **253** denotes outputs of the recording system memories **203** and numeral **254** denotes an output of the ÷m circuit **208** or a synchronizing signal divided by m.

The embodiment shown in FIG. **15** is an example in which m pairs of recording heads are used to simultaneously record magnetic signals for m pictures on m tracks, thereby realizing high-speed recording while suppressing an increase in the cylinder rotation speed. Upon reproduction, m pairs of reproducing heads are used. Though FIG. **15** shows the case where two pairs of recording heads **212** are used to simultaneously record information for two pictures on two tracks, three or more pairs of heads can be used in a similar manner.

FIG. **17** is a table showing some examples of the tape speed and the cylinder rotation speed (rpm) in the embodiments shown in FIGS. **13** and **15**. In the table, high-speed recording or reproduction at a speed ten times as high as the standard speed is shown by way of example. Design for implementing another high-speed recording or reproduction is similarly possible. In the table shown in FIG. **17**, examples ①, ② and ③ correspond to the embodiment shown in FIG. **13** and examples ④ and ⑤ correspond to the embodiment shown in FIG. **15**.

A still furthermore embodiment of a digital signal recording/reproducing system of the present invention will be explained by use of a block diagram shown in FIG. **18**.

In FIG. **18**, reference numeral **501** denotes a signal input terminal to which a plurality of video signals are inputted in a time-division multiplex form, numeral **502** a recording selection signal-input terminal to which a recording selection signal for selecting one or plural signals to be recorded from the multiplexed input signal is inputted, numeral **503** a recording signal selection circuit for selecting the signals to be recorded from the multiplexed input signal in accordance with the recording selection signal from the input terminal **502**, numeral **504** a recording signal processing circuit for subjecting the selected signals to a digital processing for recording onto a recording medium, numerals **505** and **505'** magnetic heads, numeral **506** a rotating drum, numeral **507** a magnetic tape or the recording medium, numeral **508** a servo circuit for controlling the rotation of the drum **506** and the travel of the tape **507**, numeral **511** a reproduction selection signal input terminal to which a reproduction selection signal for selecting one or plural signals to be outputted as a reproduction signal from among the multiple-recorded and reproduced signals is inputted, numeral **509** a reproduction signal selection circuit for selecting the signals to be outputted as a reproduction signal from among the multiple-recorded and reproduced signals in accordance with the reproduction selection signal from the input terminal **511**, numeral **510** a reproduction signal processing circuit for subjecting the selected signals to a digital processing, and numeral **512** a reproduction signal output terminal.

The time-division multiplexed input video signal from the signal input terminal **501** is supplied to the recording signal selection circuit **503**. The recording signal selection circuit **503** is also supplied with the recording selection signal from the recording selection signal input terminal **502** to make the selection of signals to be recorded. For example, in the case where six kinds of video signals A, B, C, D, E and F are inputted in a time-division multiplex form as shown in (a) of FIG. **19** and four signals A, B, C and D thereof are to be selected and recorded, an output of the recording signal selection circuit **503** is as shown in (b) of FIG. **19**. Such an output signal of the recording signal selection circuit **503** is inputted to the recording signal processing circuit **504** which in turn performs a signal processing for recording such as addition of error correction code. Also, the recording signal selection circuit **503** produces a speed control signal on the basis of the number of signals in the time-division multiplexed input video signal, the transmission rate of the input signal and the number of signals to be recorded which are selected by the recording selection signal. The speed control signal is supplied to the recording signal processing circuit **504** and the servo circuit **508**. For example, in the case where the input video signal is time-division multiplexed to sextuplet with each of six signals in the multiplexed input signal being transmitted at a rate time-base compressed to ⅙ and four signals among the six signals in the multiplexed input signal are to be selectively recorded, a signal indicative of a quadruple speed is produced as the speed control signal. Also, in the case where the input video signal is time-division multiplexed to sextuplet with each of six signals in the multiplexed input signal being transmitted at a rate time-base compressed to 1/12 and four signals among the six signals in the multiplexed input signal are to be selectively recorded, a signal indicative of a octuple speed is produced as the speed control

signal. Namely, in the case where an input signal is multiplexed to N-plet, the compression rate of each of the N signals in the multiplexed input signal is 1/K and the number of signals to be selectively recorded is L, a speed control signal indicative of an (L×K)/N-tuple speed is produced. The operating speed of the recording signal processing circuit **504** which processes a signal from the recording signal selection circuit **503**, is changed in accordance with the speed control signal. For example, in the case of a speed control signal indicative of a quadruple speed, the recording signal processing circuit **504** performs a signal processing at a speed four times as high as a normal speed and supplies the processed signal to the magnetic heads **505** and **505'**. Here, for example, in the case where the input video signal is time-division multiplexed to sextuplet with each of the six signals in the multiplexed input signal being transmitted at a rate time-base compressed to ⅙ and a speed control signal indicative of a quadruple speed is used to selectively record four signals from among the six signals, the speed of an input signal inputted to the recording signal processing circuit **504** is four times as high as that of one video signal having a normal speed and the recording signal processing circuit **504** processes this quadruple-speed input signal at a quadruple speed and supplies the processed signal to the magnetic heads, thereby making it possible to record all of the four selected signals. Also, if the recording signal selection circuit **503** is constructed so that signals to be selectively recorded are sequentially changed for every one track on the tape, compatibility can be held in regard to the number of signals to be selectively recorded and a processing speed by causing the recording signal processing circuit **504** to perform a completed processing for every one track. In the following, explanation will be made in conjunction with the case where each video signal is recorded in such a form completed for every track. However, it should be noted in advance that the present invention is applicable to another recording system, for example, a system in which signals are recorded in a form changed for every pixel, line or field. On the other hand, the servo circuit **508** supplied with the speed control signal indicative of the quadruple speed controls the rotation speed of the rotating drum **506** so that it becomes four times as high as a normal speed and the travel speed of the magnetic tape **507** so that it becomes four times as high as a normal speed. Thereby, four signals A, B, C and D are alternately recorded on successive tracks of the magnetic tape **507**, as shown in FIG. **20**. According to the control mentioned above, the pattern of recording tracks on the tape becomes the same irrespective of the number of signals in the multiplexed input signal, the transmission rate of each signal and the number of signals to be selectively recorded. In order to make a control upon reproduction easy, it is preferable that the number of selectively recorded signals and the identification codes or signal numbers thereof (for example, A, B, C and D or 0, 1, 2 and 3) are recorded as an ID signal for every track.

In the above example, the recording of the time-division multiplexed signal has been mentioned. However, it is needless to say that the present invention is also applicable to the case where the number of multipet signal components in an input video signal is 1 or the input video signal is not multiplexed. In such a case, since the recording signal processing circuit **504** and the servo circuit **508** operate at speeds proportional to the transmission rate of the input video signal, an effect is manifested, for example, in high-speed dubbing. As apparent from the foregoing explanation of the operation, it is of course that a multiplexed signal can be recorded at a high speed.

Upon reproduction, a signal reproduced from the magnetic tape **507** by the magnetic heads **505** and **505'** mounted on the rotating drum **506** is inputted to the reproduction signal selection circuit **509**. The reproduction signal selection circuit **509** produces a speed control signal, for example, by detecting the number of multiple-recorded signals from the ID signal included in the reproduced signal and sends the speed control signal to the servo circuit **508**. The speed control signal is a signal indicative of a speed four times as high as the normal reproduction speed in the case where the number of multiple-recorded signals is 4 and a signal indicative of a sextuple speed in the case where it is 6. In the case of the quadruple speed, the servo control circuit **508** supplied with the speed control signal indicative of the quadruple speed controls the rotation speed of the rotating drum **506** so that it becomes four times as high as a normal speed and the travel speed of the magnetic tape **7** so that it becomes four times as high as a normal speed. Thereby, there can be traced all of signals recorded so that the recording track pattern on the tape becomes the same irrespective of the number of signals to be selectively recorded. In a system which has not a signal indicative of the number of selectively recorded signals, there may be employed a method in which the speed control signal is manually set. In a system in which the number of signals to be recorded on the tape is fixed, the speed control signal has a fixed value. The reproduction signal selection circuit **509** receives a reproduction selection signal inputted from the reproduction selection signal input terminal **511** to select a desired signal(s) from among the signals reproduced by the magnetic heads **505** and **505'** and to output the selected signal as a reproduction signal to the reproduction signal processing circuit **510**. The reproduction signal selection circuit **509** also outputs a selection number signal indicative of the number of selected signals to the reproduction signal processing circuit **510**.

The reproduction signal processing circuit **510** performs a signal processing such as code error correction processing and picture signal processing for the reproduction signal at a processing speed corresponding, to the selection number signal and outputs the processed reproduction signal from the output terminal **512**. For example, in the case where the number indicated by the selection number signal is 2, the signal processing speed is two times as high as a normal speed and various processings are performed for each selected signal. For example, in the case where signals A and C are selected, the signals A and C are outputted alternately for each field. In the case where the number indicated by the selection number signal is 1, for example, when the reproduction selection signal from the reproduction selection signal input terminal **511** selects only the signal C, the reproduction signal processing circuit **510** performs the signal processing at the normal speed to output the signal as reproduced at a normal speed. As apparent from the above, the present embodiment makes it possible to simultaneously record any number of signals selected from among a plurality of signals in a multiplexed video signal and to simultaneously reproduce any number of signals from among the recorded signals.

In the case where a plurality of signals are simultaneously reproduced, a construction for outputting the reproduced signals from separate output terminals simultaneously and in parallel may be employed, particularly, in the case of an analog output, as a method other than the construction in which the plurality of reproduced signals are outputted in a time-division multiplex form, as mentioned above. Though in the above-mentioned example the reproduction signal is outputted at a reproduction speed for a usual video signal, the transmission rate of the reproduction signal may be made

higher than the reproduction speed for the usual video signal in order to transmit the reproduction signal to another system in an analog or digital signal form at a high rate or to perform high-speed dubbing which is one of effects of the present embodiment. This can be realized in such a manner that the fundamental operating speed of there producing system is set to be higher than a normal reproduction speed and the operating speeds of the servo circuit **508**, the reproduction signal selection circuit **509** and the reproduction signal processing circuit **510** are changed in accordance with the number of multiple-recorded signals and/or the number of signals to be outputted as a reproduction signal with the above fundamental speed being the standard. If the transmission rate of a reproduction signal is made variable so that a rate adapted for a transmission path to which the reproduction signal is to be connected or the performance or function of a recorder by which the reproduction signal is to be recorded, can be selected.

As mentioned above, according to the present embodiment, it is possible to simultaneously record any number of signals selected from among a plurality of signals in a multiplexed video signal and to reproduce any number of signals from among the recorded signals at any speed. Also, in the case where a plurality of signals are selected and reproduced and the plurality of reproduced signals are simultaneously outputted in a time-division multiplex form or from separate output terminals in parallel, it is possible to arbitrarily set the transmission rate of an output signal.

The present embodiment has been explained in conjunction with the case where the present invention is applied to a helical-scan digital-recording VTR. It is of course that a similar effect can be obtained in the case where the present invention is applied to a fixed head VTR. The fixed head system is convenient for the structuring of a system since it has a higher degree of freedom for the setting of the units of division of a signal subjected to time-division multiple recording as compared with the helical scan system. Also, it is of course that the present invention is applicable to a recording/reproducing equipment other than the VTR or is applicable to a digital signal processing and analog recording system.

The present invention can be applied to not only the case where an input signal is time-division multiplexed, as mentioned above, but also the case where a plurality of signals are inputted simultaneously and in parallel. In the latter case, the recording signal selection circuit **503** is constructed to receive the input signals in parallel.

As has been mentioned in the foregoing, according to the present invention, it is possible to realize a digital VTR in which high-speed recording onto a tape can be made with the same format as that used in standard-speed reproduction. Further, there can be realized a transmission signal processing for transmitting at a high rate a video signal to be recorded by such a digital VTR. Also, in the case where a signal transmitted from the transmission signal processing system is to be recorded by a multiplicity of VTR's, it is possible to designate those ones of the multiplicity of VTR's by which recording is to be made and to make a control of the start/stop of recording.

What is claimed is:

1. A digital information receiving apparatus, comprising:

a receiver configured to receive digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error detection information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate the digital information received by the receiver;

an error detector configured to detect an error which occurs in the transmission path of the digital information demodulated by the demodulator based on the error detection information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

a first expander configured to bit-expand the video information of the digital information error detected by the error detector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of the digital information error detected by the error detector in accordance with a second expansion method corresponding to the second compression method.

2. A digital information receiving apparatus, according to claim **1**, wherein the first compression method utilizes a discrete cosine transform.

3. A digital information receiving apparatus, comprising;

a receiver configured to receive digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate the digital information received by the receiver;

an error corrector configured to correct an error which occurs in the transmission path of the digital information demodulated by the demodulator based on the error correction information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

a first expander configured to bit-expand the video information of the digital information error corrected by the error corrector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of the digital information error corrected by the error corrector in accordance with a second expansion method corresponding to the second compression method.

4. A digital information receiving apparatus, according to claim **3**, wherein the first compression method utilizes a discrete cosine transform.

5. A digital information receiving and recording apparatus comprising:

a receiver configured to receive digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and transmission error correction information added to the video information and separately added to the audio information, respectively;

an error corrector configured to correct an error of the digital information received by the receiver based on the transmission error correction information, the error

being the error which occurs in the transmission path having no recording process of the digital information therein;

a record error correction information adder configured to add record error correction information to the video information and the audio information error corrected by the error corrector, the record error correction information being different from the transmission error correction information; and

a recorder configured to record the digital information added the record correction information by the record error correction information adder to the recording medium.

6. A digital information receiving and recording apparatus, according to claim **5**, wherein the first compression method utilizes a discrete cosine transform.

7. A method for receiving digital information of a digital information receiving apparatus, comprising the steps of:

receiving the digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error detection information added to the video information and separately added to the audio information, respectively;

demodulating the digital information received by the receiving step;

detecting an error of the digital information demodulated by the demodulating step based on the error detection information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

bit-expanding the video information of the digital information error detected by the error detecting step in accordance with a first expansion method corresponding to the first compression method; and

bit-expanding the audio information of the digital information error detected by the error detecting step in accordance with a second expansion method corresponding to the second compression method.

8. A method for receiving digital information of a digital information receiving apparatus, according to claim **7**, wherein the first compression method utilizes a discrete cosine transform.

9. A method for receiving a digital information of a digital information receiving apparatus, comprising the steps of:

receiving digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

demodulating the digital information received by the receiving step;

correcting an error of the digital information demodulated by the demodulating step based on the error correction information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

bit-expanding the video information of the digital information by the error correcting step in accordance with a first expansion method corresponding to the first compression method; and

bit-expanding the audio information of the digital information error corrected by the error correcting step in accordance with a second expansion method corresponding to the second compression method.

10. A method for receiving a digital information of a digital information receiving apparatus, according to claim **9**, wherein the first compression method utilizes a discrete cosine transform.

11. A method for receiving a digital information of a digital information receiving apparatus, comprising the steps of:

receiving digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and transmission error correction information added to the video information and separately added to the audio information, respectively;

correcting an error of the digital information received by the receiving step based on the transmission error correction information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

adding record error correction information to the video information and the audio information error corrected by the error correcting step, the record error correction information being different from the transmission error correction information; and

recording the digital information having the record correction information added by the adding step to the recording medium.

12. A method for receiving a digital information of a digital information receiving apparatus, according to claim **11**, wherein the first compression method utilizes a discrete cosine transform.

13. A digital information receiving apparatus, comprising:

receiving means for receiving digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error detection information added to the video information and separately added to the audio information, respectively;

demodulating means for demodulating the digital information received by the receiving means;

error detecting means for detecting an error of the digital information demodulated by the demodulating means based on the error detection information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

first expanding means for bit-expanding the video information of the digital information error detected by the error detecting means in accordance with a first expansion method corresponding to the first compression method; and

second expanding means for bit-expanding the audio information of the digital information error detected by the error detecting means in accordance with a second expansion method corresponding to the second compression method.

14. A digital information receiving apparatus, according to claim **13**, wherein the first compression method utilizes a discrete cosine transform.

15. A digital information receiving apparatus, comprising;

receiving means for receiving digital information from a transmission path, wherein the digital information

includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

demodulating means for demodulating the digital information received by the receiving means;

error correcting means for correcting an error of the digital information demodulated by the demodulating means based on the error correction information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

first expanding means for bit-expanding the video information of the digital information error corrected by the error correcting means in accordance with a first expansion method corresponding to the first compression method; and

second expanding means for bit-expanding the audio information of the digital information error corrected by the error correcting means in accordance with a second expansion method corresponding to the second compression method.

16. A digital information receiving apparatus, according to claim **15**, wherein the first compression method utilizes a discrete cosine transform.

17. A digital information receiving apparatus, comprising:

a receiver configured to receive digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error detection information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate a digital information which is previously received by the receiver;

an error detector configured to detect an error of a digital information which is previously demodulated by the demodulator based on the error detection information, the error being the error which occurs in the transmission path having no recording process of a digital information therein;

a first expander configured to bit-expand the video information of a digital information which is previously error detected by the error detector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of a digital information which is previously error detected by the error detector in accordance with a second expansion method corresponding to the second compression method.

18. A digital information receiving apparatus, according to claim **17**, wherein the first compression method utilizes a discrete cosine transform.

19. A digital information receiving apparatus, comprising;

a receiver configured to receive digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate a digital information which is previously received by the receiver;

an error corrector configured to correct an error of a digital information which is previously demodulated by the demodulator based on the error correction information, the error being the error which occurs in the transmission path having no recording process of a digital information therein;

a first expander configured to bit-expand the video information of a digital information which is previously error corrected by the error corrector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of a digital information which is previously error corrected by the error corrector in accordance with a second expansion method corresponding to the second compression method.

20. A digital information receiving apparatus, according to claim **19**, wherein the first compression method utilizes a discrete cosine transform.

21. A digital information receiving apparatus, comprising:

receiving means for receiving digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error detection information added to the video information and separately added to the audio information, respectively;

demodulating means for demodulating a digital information which is previously received by the receiving means;

error detecting means for detecting an error of a digital information which is previously demodulated by the demodulating means based on the error detection information, the error being the error which occurs in the transmission path having no recording process of a digital information therein;

first expanding means for bit-expanding the video information of a digital information which is previously error detected by the error detecting means in accordance with a first expansion method corresponding to the first compression method; and

second expanding means for bit-expanding the audio information of a digital information which is previously error detected by the error detecting means in accordance with a second expansion method corresponding to the second compression method.

22. A digital information receiving apparatus, according to claim **21**, wherein the first compression method utilizes a discrete cosine transform.

23. A digital information receiving apparatus, comprising;

receiving means for receiving digital information from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

demodulating means for demodulating a digital information which is previously received by the receiving means;

error correcting means for correcting an error of a digital information which is previously demodulated by the demodulating means based on the error correction infor-

mation, the error being the error which occurs in the transmission path having no recording process of a digital information therein;

first expanding means for bit-expanding the video information of a digital information which is previously error corrected by the error correcting means in accordance with a first expansion method corresponding to the first compression method; and

second expanding means for bit-expanding the audio information of a digital information which is previously error corrected by the error correcting means in accordance with a second expansion method corresponding to the second compression method.

24. A digital information receiving apparatus, according to claim **23**, wherein the first compression method utilizes a discrete cosine transform.

25. A digital information receiving apparatus, comprising;

a receiver configured to receive digital information transmitted in electric wave form from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate the digital information received by the receiver;

an error corrector configured to correct an error of the digital information demodulated by the demodulator based on the error correction information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

a first expander configured to bit-expand the video information of the digital information error corrected by the error corrector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of the digital information error corrected by the error corrector in accordance with a second expansion method corresponding to the second compression method.

26. A digital information receiving apparatus, according to claim **25**, wherein the first compression method utilizes a discrete cosine transform.

27. A method for receiving a digital information of a digital information receiving apparatus, comprising the steps of:

receiving digital information transmitted in electric wave form from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

demodulating the digital information received by the receiving step;

correcting an error of the digital information demodulated by the demodulating step based on the error correction information, the error being the error which occurs in the transmission path having no recording process of the digital information therein;

bit-expanding the video information of the digital information by the error correcting step in accordance with a first expansion method corresponding to the first compression method; and

bit-expanding the audio information of the digital information error corrected by the error correcting step in accordance with a second expansion method corresponding to the second compression method.

28. A method for receiving a digital information of a digital information receiving apparatus, according to claim **27**, wherein the first compression method utilizes a discrete cosine transform.

29. A digital information receiving apparatus, comprising;

a receiver configured to receive digital information transmitted in electric wave form from a transmission path, wherein the digital information includes video information bit-compressed by a first compression method, audio information bit-compressed by a second compression method which is different from the first compression method, and error correction information added to the video information and separately added to the audio information, respectively;

a demodulator configured to demodulate a digital information which is previously received by the receiver;

an error corrector configured to correct an error of a digital information which is previously demodulated by the demodulator based on the error correction information, the error being the error which occurs in the transmission path having no recording process of a digital information therein;

a first expander configured to bit-expand the video information of a digital information which is previously error corrected by the error corrector in accordance with a first expansion method corresponding to the first compression method; and

a second expander configured to bit-expand the audio information of a digital information which is previously error corrected by the error corrector in accordance with a second expansion method corresponding to the second compression method.

30. A digital information receiving apparatus, according to claim **29**, wherein the first compression method utilizes a discrete cosine transform.

31. A digital information receiving apparatus, according to claim **1**, further comprising:

a control signal detector configured to detect control signal information generated by a control signal generator.

32. A digital information receiving apparatus, according to claim **31**, further comprising:

a parity addition circuit configured to add parities to the control signal information.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 8,009,375 B2
APPLICATION NO.	: 11/305229
DATED	: August 30, 2011
INVENTOR(S)	: H. Arai et al.

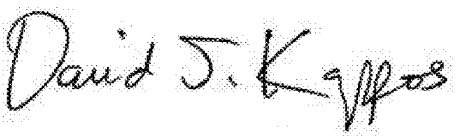
It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page

Under the head (*) Notice:

Please **delete** the sentence "This patent is subject to a Terminal Disclaimer."

Signed and Sealed this
Eighteenth Day of October, 2011



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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 8,009,375 B2
APPLICATION NO.	: 11/305229
DATED	: August 30, 2011
INVENTOR(S)	: H. Arai et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Title Page

Item (60): on line 18 of 'Related U.S. Application Data,' immediately following the listing of Pat. No. 5,862,004, – please insert the following -- which is a continuation of application No. 08/620,880, filed Mar. 22, 1996, now Pat. No. 5,673,154, --

Signed and Sealed this
Fourteenth Day of February, 2012

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

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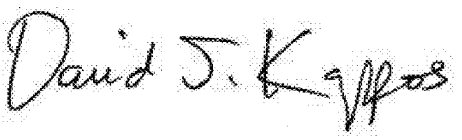
Title Page

Item (60): on line 18 of 'Related U.S. Application Data,' immediately following the listing of Pat. No. 5,699,203, – please insert the following -- which is a continuation of application No. 08/620,880, filed Mar. 22, 1996, now Pat. No. 5,673,154, --

This certificate supersedes the Certificate of Correction issued February 14, 2012.

Signed and Sealed this
Twenty-fifth Day of September, 2012



David J. Kappos
Director of the United States Patent and Trademark Office

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United States Patent [19]

Yamaashi et al.

[11] Patent Number: 5,502,497

[45] Date of Patent: Mar. 26, 1996

[54] **TELEVISION BROADCASTING METHOD AND SYSTEM ENABLING PICTURE BROADCASTING FROM THE TRANSMITTING EQUIPMENT TO THE RECEIVING EQUIPMENT USING ALTERNATIVE BROADCASTING SYSTEM STANDARDS**

[75] Inventors: **Kimiya Yamaashi**, Hitachi; **Masayuki Tani**, Katsuta; **Koichiro Tanikoshi**, Hitachi; **Masayasu Futakawa**, Hitachi; **Shinya Tanifuji**, Hitachi; **Atsushi Kawabata**, Hitachi; **Norito Watanabe**, Hitachi; **Kazunari Maeda**, Tondabayashi, all of Japan

[73] Assignee: **Hitachi, Ltd.**, Tokyo, Japan

[21] Appl. No.: **470,449**

[22] Filed: **Jun. 6, 1995**

Related U.S. Application Data

[63] Continuation of Ser. No. 936,779, Aug. 28, 1992, abandoned.

[30] **Foreign Application Priority Data**

Aug. 28, 1991 [JP] Japan 3-217508

[51] **Int. Cl.**[6] **H04N 7/08**

[52] **U.S. Cl.** **348/473**; 348/476

[58] **Field of Search** 348/473, 474, 348/484, 476, 6, 7, 10; 358/142, 143, 147, 146, 86; H04N 7/08

[56] **References Cited**

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Primary Examiner—James J. Groody
Assistant Examiner—Sherrie Hsia
Attorney, Agent, or Firm—Antonelli, Terry, Stout & Kraus

[57] **ABSTRACT**

A television broadcasting system intended to bestow a certain level of selectivity on compression systems and multiplexing systems for broadcast program pictures. A transmitting equipment transmits the broadcast program pictures, and transmits control information on transmission systems for the transmitted broadcast program pictures. A receiving equipment includes a reception module which receives a program channel having a plurality of sorts of video information multiplexed therein, selected by a viewer, and also the control information concerning the selected program channel. A reception controller commands a signal separator to produce the outputs of the video information interleaved in those positions of the program channel which are designated by the control information. Besides, the reception controller sends a decoder a decoding program contained in the control information. The decoder executes the sent decoding program so as to decode the output video information of the signal separator and to display the decoded video information on a display unit.

18 Claims, 13 Drawing Sheets

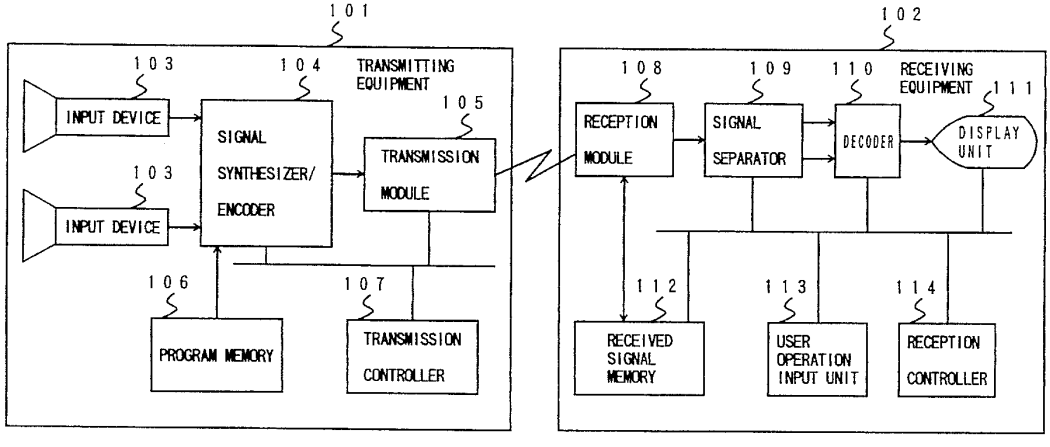


FIG. 1

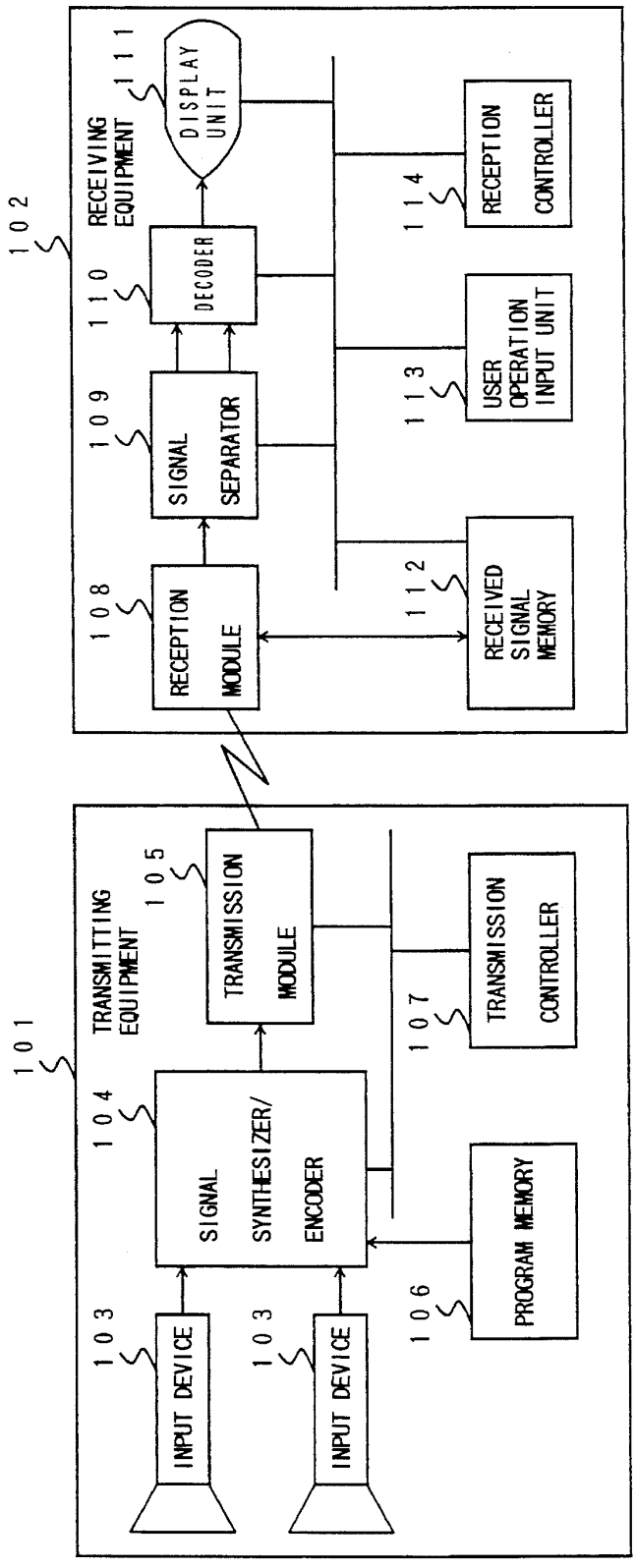

101
TRANSMITTING EQUIPMENT
102
RECEIVING EQUIPMENT
103
INPUT DEVICE
103
INPUT DEVICE
104
SIGNAL SYNTHESIZER/ ENCODER
105
TRANSMISSION MODULE
106
PROGRAM MEMORY
107
TRANSMISSION CONTROLLER
108
RECEPTION MODULE
109
SIGNAL SEPARATOR
110
DECODER
111
DISPLAY UNIT
112
RECEIVED SIGNAL MEMORY
113
USER OPERATION INPUT UNIT
114
RECEPTION CONTROLLER

FIG. 2

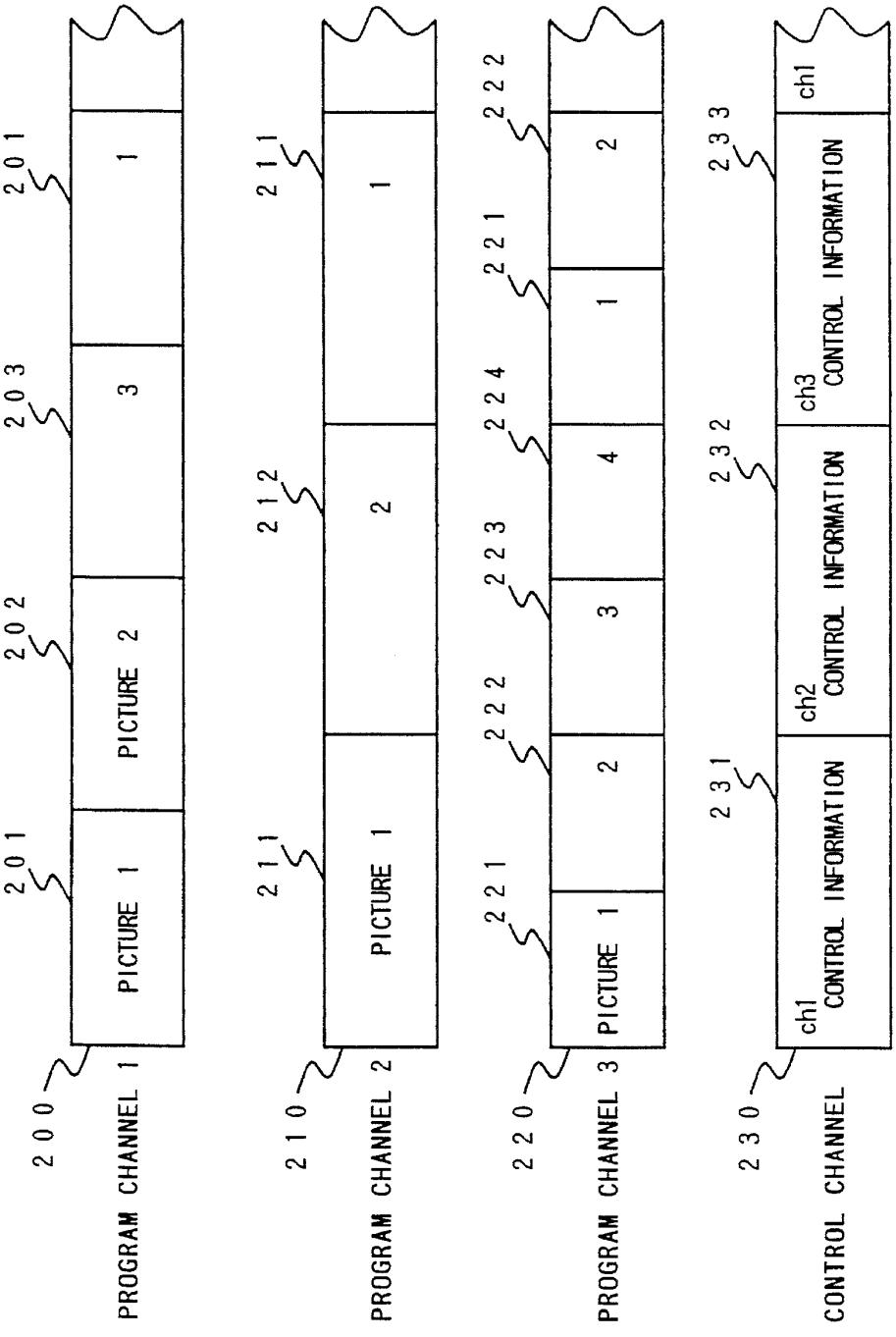

200
PROGRAM CHANNEL 1
201
PICTURE 1
202
PICTURE 2
203
3
201
1
210
PROGRAM CHANNEL 2
211
PICTURE 1
212
2
211
1
220
PROGRAM CHANNEL 3
221
PICTURE 1
222
2
223
3
224
4
221
1
222
2
230
CONTROL CHANNEL
231
ch1
CONTROL INFORMATION
232
ch2
CONTROL INFORMATION
233
ch3
CONTROL INFORMATION
ch1

FIG. 3

300

	ITEMS	CONTENTS	CONCRETE CONTENTS	
310	PROGRAM ID	UNIQUE No. OF PROGRAM	NUMERAL OF 32 BITS PECULIAR TO EACH PROGRAM	
320	PICTURE INFORMATION	PICTURE SIZE	525" 525	321
		NUMBERS OF PICTURES AND FRAMES	30 FRAMES/SEC. 3 PICTURES/FRAME	322
		PIXEL COMPOSITION	8 BITS FOR EACH OF R, G AND B COMPONENTS	323
		PIXEL ARRAYAL	RGB	324
330	COMMUNICATION INFORMATION	COM. SYSTEM	PCM/FM	331
		NUMBER OF BITS	8 BITS	332
		SYNC FRAME SIGNAL	○×FFFFFFFF	333
340	CONTROLLING PROGRAM	CONTROL PROGRAM	CONTROL PROGRAM	341
		PICTURE DECODING PROGRAM	SIMPLE RUN LENGTH	342
		INTERACTUAL IMAGE	MENU IMAGE	343

FIG. 4

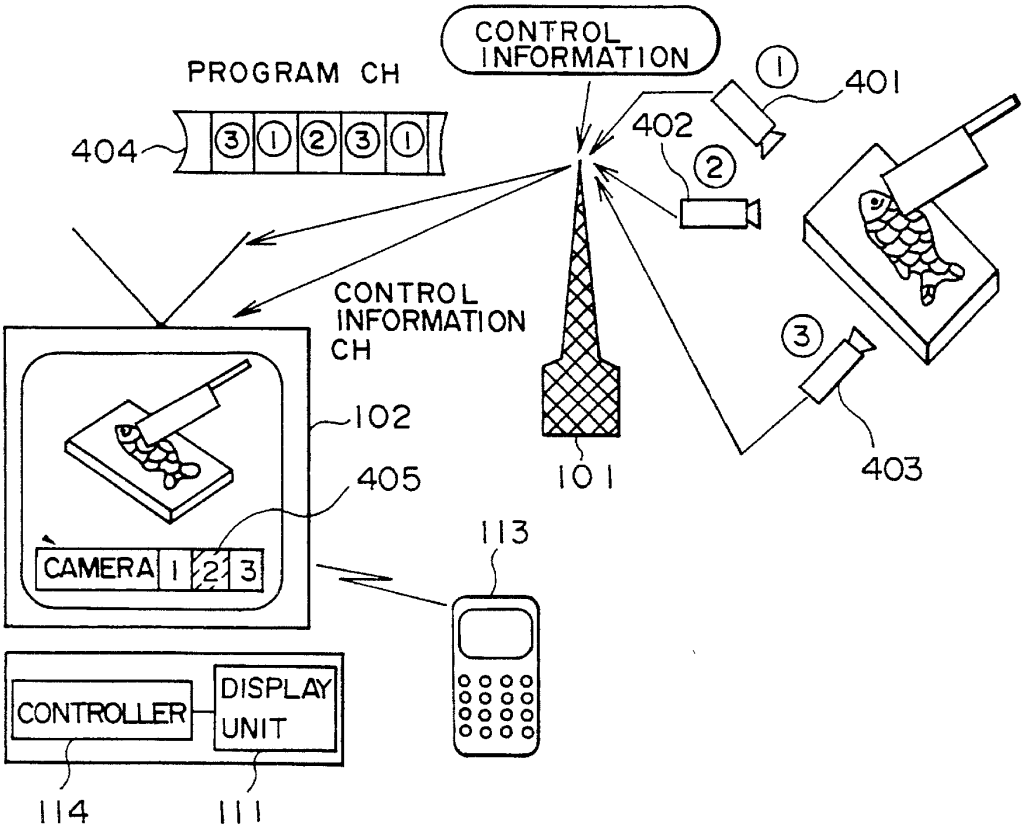

CONTROL INFORMATION
PROGRAM CH
404
3 1 2 3 1
401
402
CONTROL INFORMATION CH
102
405
101
403
113
CAMERA 1 2 3
CONTROLLER
DISPLAY UNIT
114
111

FIG. 5

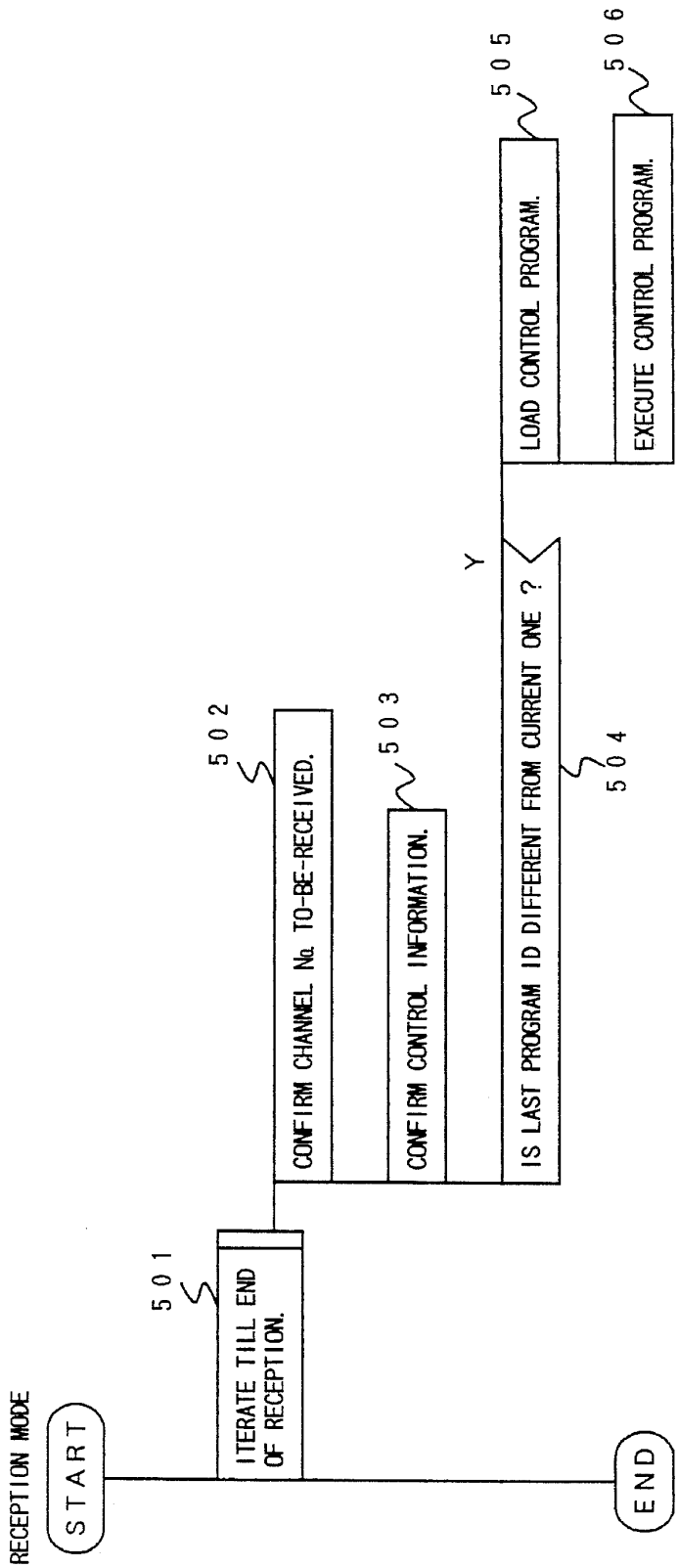

RECEPTION MODE
START
501
ITERATE TILL END OF RECEPTION.
502
CONFIRM CHANNEL No. TO-BE-RECEIVED.
503
CONFIRM CONTROL INFORMATION.
504
IS LAST PROGRAM ID DIFFERENT FROM CURRENT ONE ?
Y
505
LOAD CONTROL PROGRAM.
506
EXECUTE CONTROL PROGRAM.
END

FIG. 6

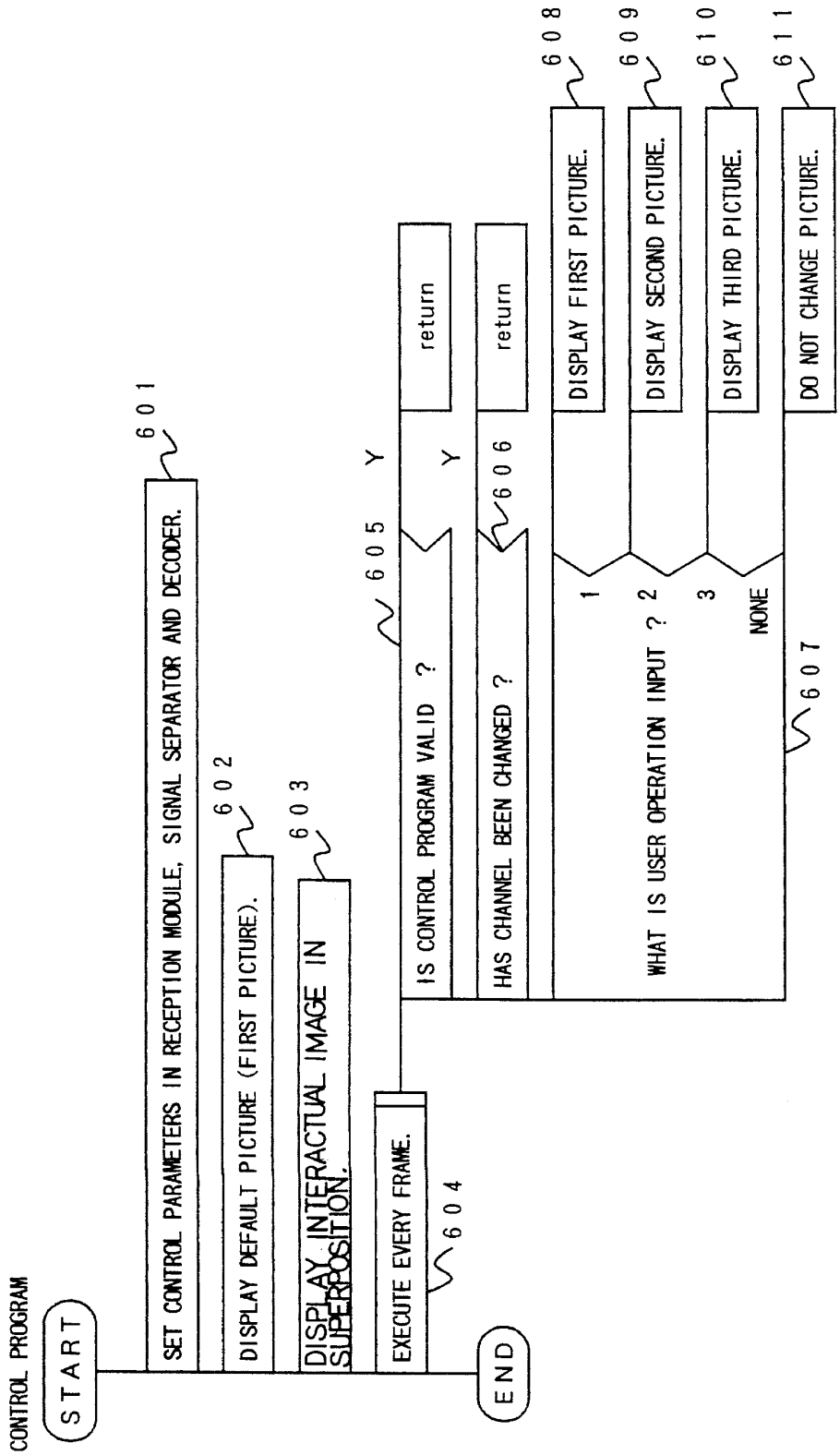

CONTROL PROGRAM
START
SET CONTROL PARAMETERS IN RECEPTION MODULE, SIGNAL SEPARATOR AND DECODER.
601
DISPLAY DEFAULT PICTURE (FIRST PICTURE).
602
DISPLAY INTERACTUAL IMAGE IN SUPERPOSITION.
603
EXECUTE EVERY FRAME.
604
IS CONTROL PROGRAM VALID ?
605
Y
return
HAS CHANNEL BEEN CHANGED ?
606
Y
return
WHAT IS USER OPERATION INPUT ?
1
2
3
NONE
607
DISPLAY FIRST PICTURE.
608
DISPLAY SECOND PICTURE.
609
DISPLAY THIRD PICTURE.
610
DO NOT CHANGE PICTURE.
611
END

FIG. 7

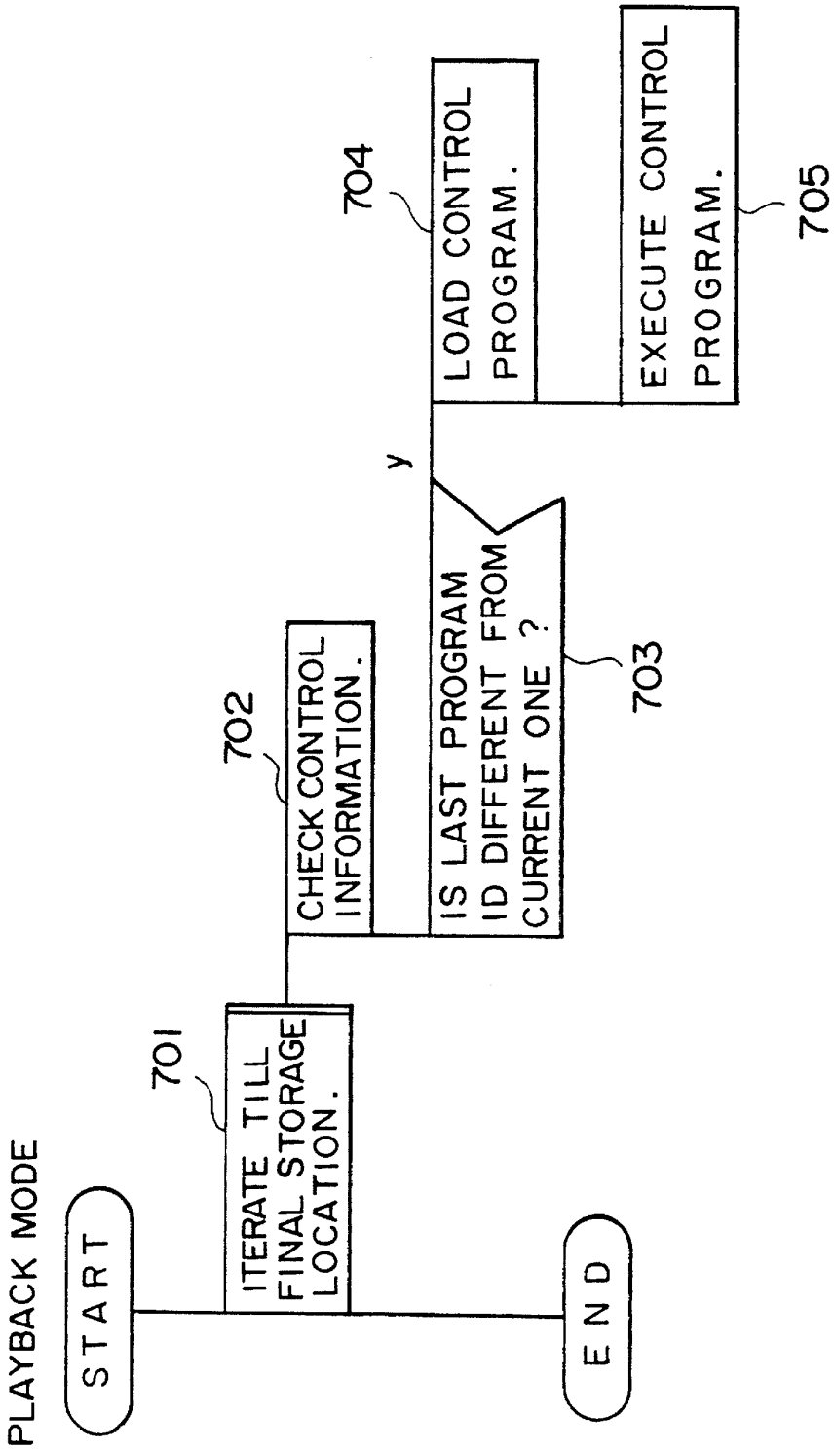

PLAYBACK MODE
START
701
ITERATE TILL FINAL STORAGE LOCATION.
702
CHECK CONTROL INFORMATION.
703
IS LAST PROGRAM ID DIFFERENT FROM CURRENT ONE ?
y
704
LOAD CONTROL PROGRAM.
705
EXECUTE CONTROL PROGRAM.
END

FIG. 8

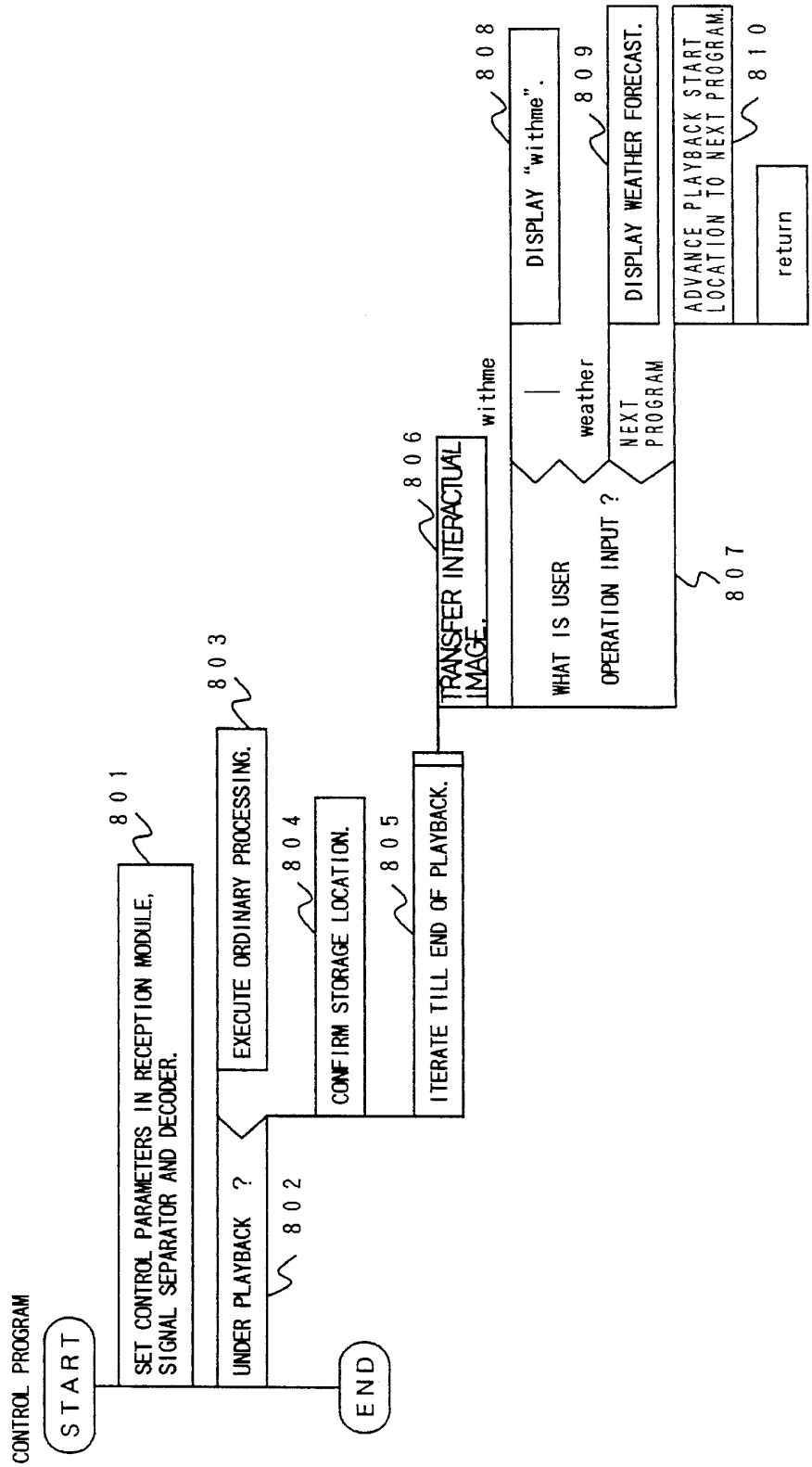

CONTROL PROGRAM
START
801
SET CONTROL PARAMETERS IN RECEPTION MODULE, SIGNAL SEPARATOR AND DECODER.
802
UNDER PLAYBACK ?
803
EXECUTE ORDINARY PROCESSING.
804
CONFIRM STORAGE LOCATION.
805
ITERATE TILL END OF PLAYBACK.
END
806
TRANSFER INTERACTIAL IMAGE.
807
WHAT IS USER OPERATION INPUT ?
withme
weather
NEXT PROGRAM
808
DISPLAY "withme".
809
DISPLAY WEATHER FORECAST.
810
ADVANCE PLAYBACK START LOCATION TO NEXT PROGRAM.
return

FIG. 9

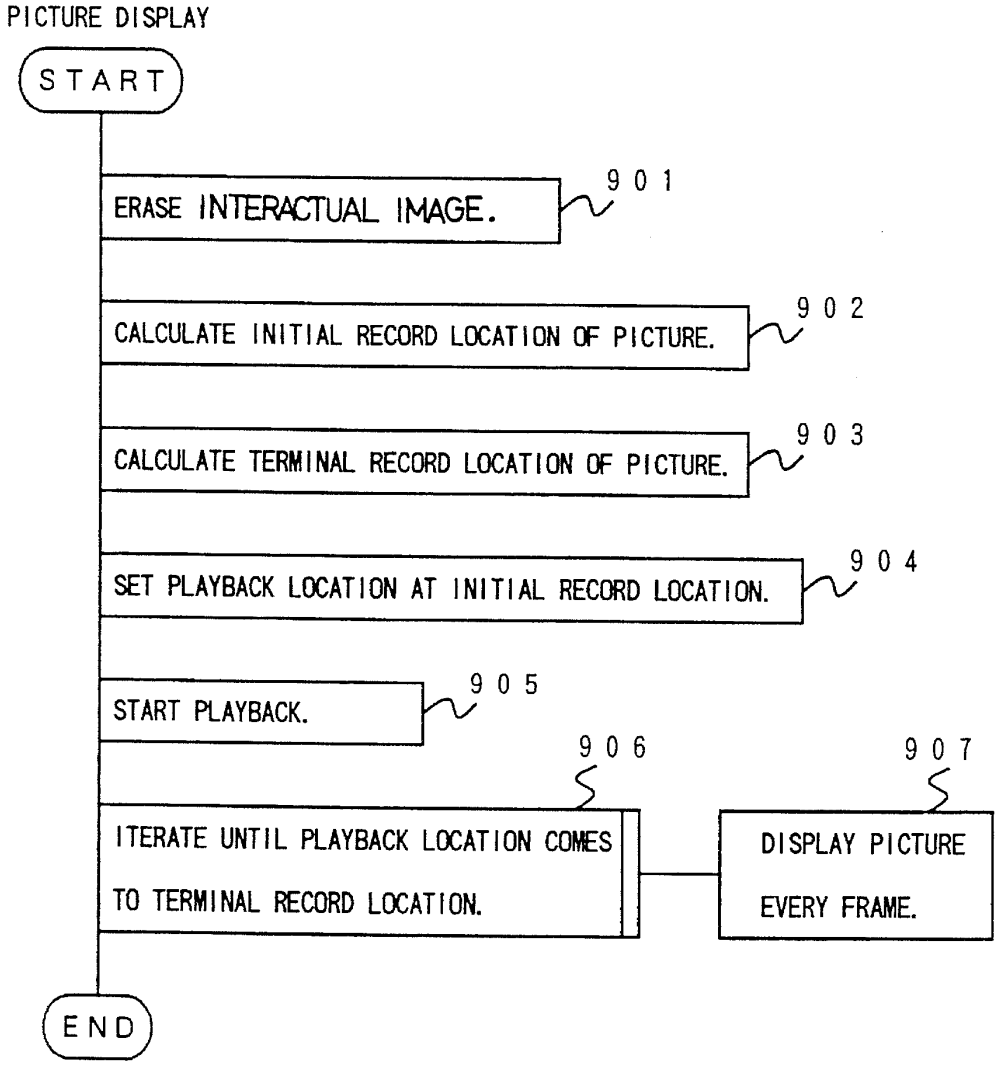

PICTURE DISPLAY
START
ERASE INTERACTUAL IMAGE.
901
CALCULATE INITIAL RECORD LOCATION OF PICTURE.
902
CALCULATE TERMINAL RECORD LOCATION OF PICTURE.
903
SET PLAYBACK LOCATION AT INITIAL RECORD LOCATION.
904
START PLAYBACK.
905
906
ITERATE UNTIL PLAYBACK LOCATION COMES TO TERMINAL RECORD LOCATION.
907
DISPLAY PICTURE EVERY FRAME.
END

FIG. 10

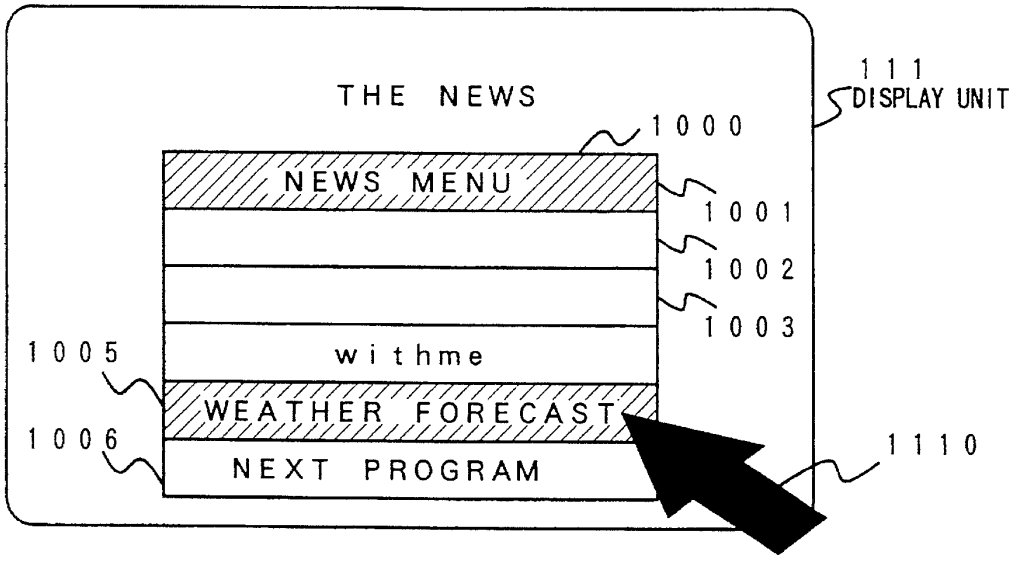

THE NEWS
1000
111
DISPLAY UNIT
NEWS MENU
1001
1002
1003
1005
withme
WEATHER FORECAST
1006
NEXT PROGRAM
1110

FIG. 11

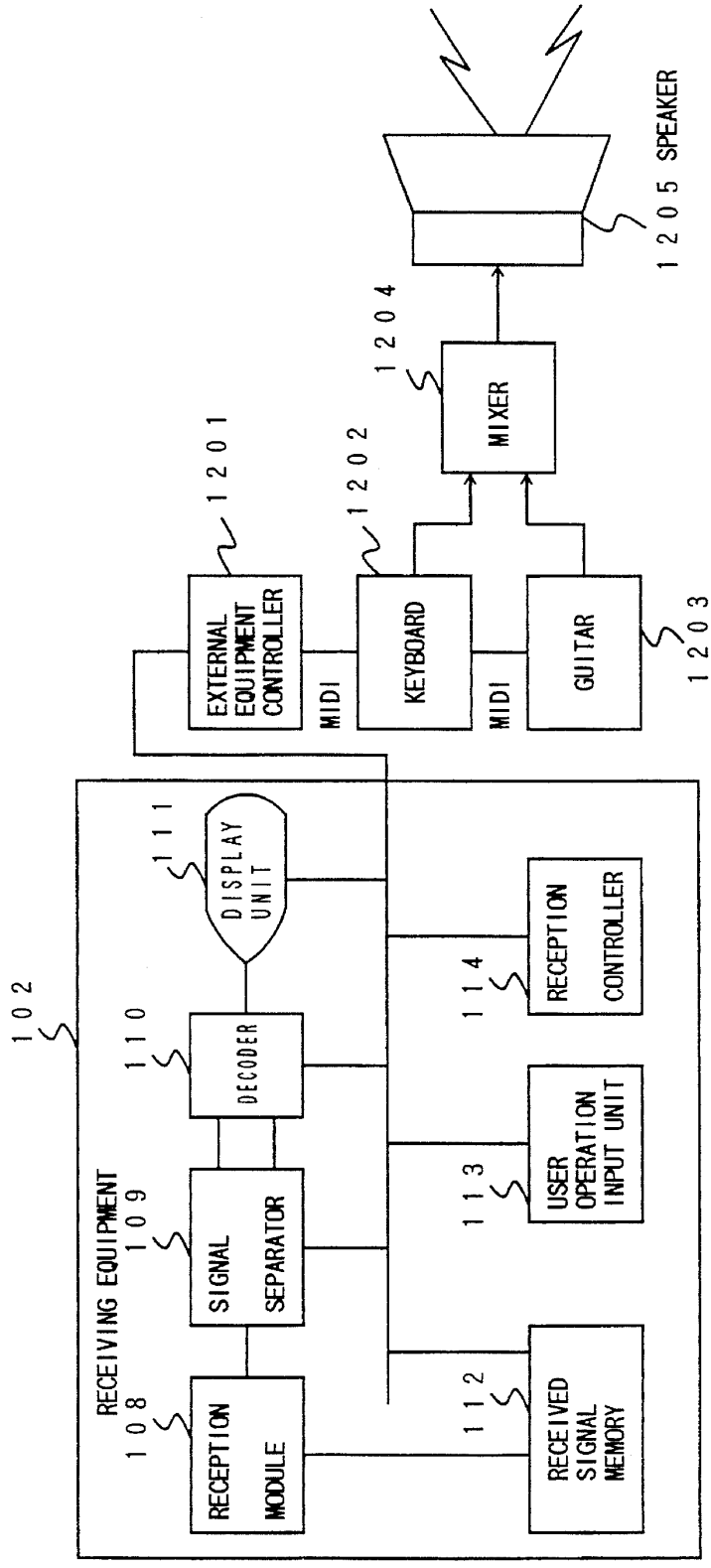

1205 SPEAKER
1204
MIXER
1201
1202
EXTERNAL EQUIPMENT CONTROLLER
MIDI
KEYBOARD
MIDI
GUITAR
1203
102
RECEIVING EQUIPMENT
108
RECEPTION MODULE
109
SIGNAL SEPARATOR
110
DECODER
111
DISPLAY UNIT
112
RECEIVED SIGNAL MEMORY
113
USER OPERATION INPUT UNIT
114
RECEPTION CONTROLLER

FIG. 12A

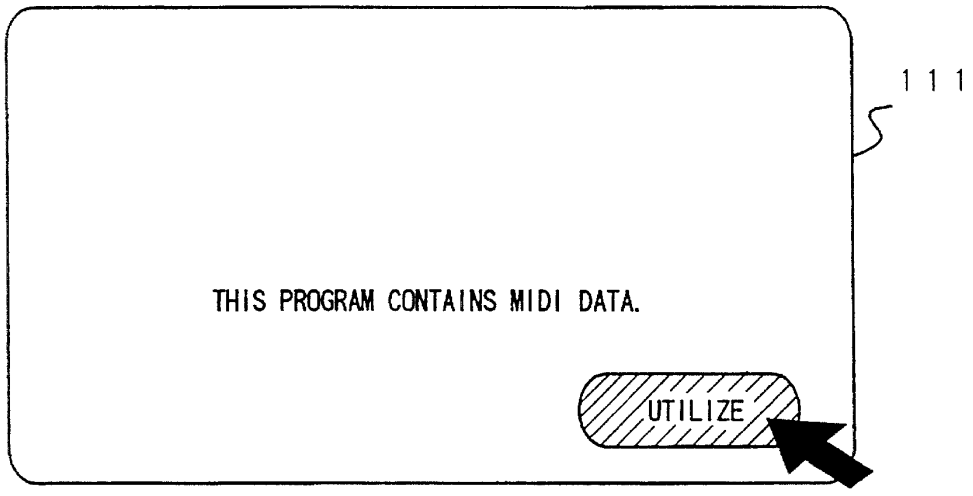


FIG. 12B

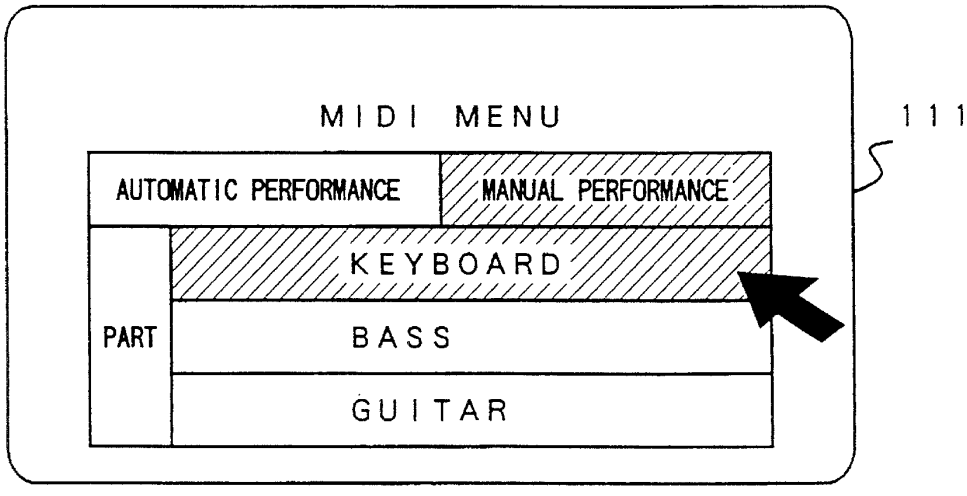
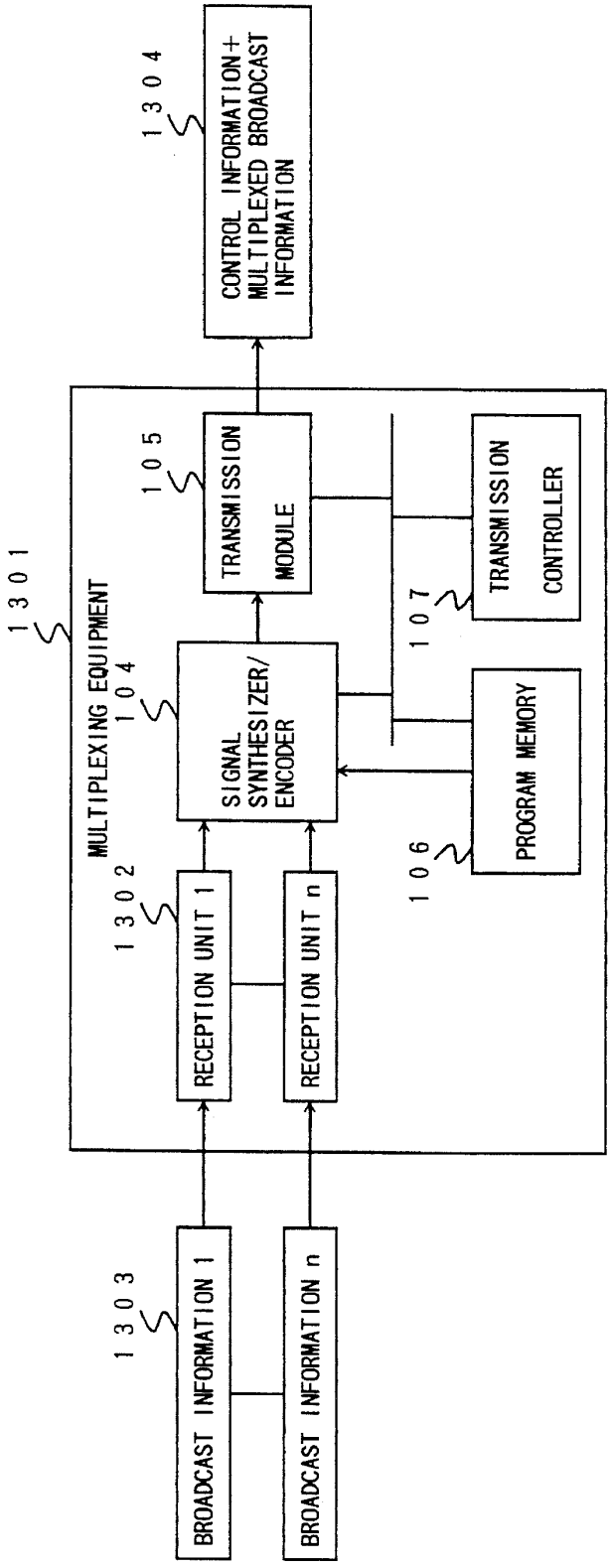


FIG. 13


1304
CONTROL INFORMATION+ MULTIPLEXED BROADCAST INFORMATION
1301
MULTIPLEXING EQUIPMENT
105
TRANSMISSION MODULE
107
TRANSMISSION CONTROLLER
104
SIGNAL SYNTHESIZER/ ENCODER
106
PROGRAM MEMORY
1302
RECEPTION UNIT 1
RECEPTION UNIT n
1303
BROADCAST INFORMATION 1
BROADCAST INFORMATION n

TELEVISION BROADCASTING METHOD AND SYSTEM ENABLING PICTURE BROADCASTING FROM THE TRANSMITTING EQUIPMENT TO THE RECEIVING EQUIPMENT USING ALTERNATIVE BROADCASTING SYSTEM STANDARDS

This application is a continuation application of Ser. No. 07/936,779, filed Aug. 28, 1992, now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to broadcasting communication systems for television broadcasting, radio broadcasting, etc. More particularly, it relates to a broadcasting system which features an arrangement wherein control information items for viewing broadcast contents are also transmitted and received.

Various broadcasting systems are adopted for present-day television broadcasting.

By way of example, the NTSC system is a broadcast system standard generally employed in Japan. In addition to the NTSC system, the PAL system and the SECAM system are employed in many other countries.

Besides, the ISDB (Integrated Services Digital Broadcasting) system has been studied wherein video signals are digitized and then turned into compressed codes, which are subjected to time-division multiplexed transmission.

In general, one receiving set can receive a plurality of broadcasts allotted to different channels as long as the broadcasts are in an identical broadcasting form. Thus, a viewer selects one of the plurality of channels which his/her receiving set can receive, in accordance with desired information, and he/she views the picture of the selected channel.

SUMMARY OF THE INVENTION

The present invention has for its object an attention to provide a television broadcasting system in which compression systems, multiplexing systems, the selections of pictures by viewers, etc. are rendered flexible in order to offer multifarious services to the viewers.

The present invention consists of a television broadcasting system having a transmitting equipment which transmits a broadcast program picture, and a receiving equipment which receives and displays the transmitted broadcast program picture; characterized in that the transmitting equipment transmits control information for specifying a transmission system for the transmitted broadcast program picture, and that said receiving equipment receives the control information on the basis of a predetermined standard and then receives and displays said broadcast program picture transmitted from the transmitting equipment, on the basis of the received control information.

Accordingly, the transmission systems such as encoding systems and multiplexing systems can be flexibly selected depending upon various conditions such as the characteristics of the broadcast program pictures to-be-transmitted, and multifarious services can be offered to the viewers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram showing the architecture of a television broadcasting system according to an embodiment of the present invention;

FIG. **2** is an explanatory diagram showing the situation of broadcasting channels for use in the embodiment;

FIG. **3** is an explanatory diagram showing control information for use in the embodiment;

FIG. **4** is an explanatory diagram showing the first operating example of the television broadcasting system of the embodiment;

FIG. **5** is a flow chart showing the reception operation of a reception controller in the first operating example;

FIG. **6** is a flow chart showing a control program which is run by the reception controller in the first operating example;

FIG. **7** is a flow chart showing the playback operation of a reception controller in the second operating example;

FIG. **8** is a flow chart showing a control program which is run by the reception controller in the second operating example;

FIG. **9** is a flow chart showing the picture display operation of the reception controller in the second operating example;

FIG. **10** is an explanatory diagram showing a menu which is displayed on a display unit in the second operating example;

FIG. **11** is a block diagram showing the construction of a receiving side system in the third operating example;

FIGS. **12**A and **12**B are diagrams for explaining a menu which is displayed on a display unit in the third operating example; and

FIG. **13** is a block diagram showing the construction of a transmitting side system in the fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Now, an embodiment of the present invention will be described.

First, the architecture of a television broadcasting system according to this embodiment is illustrated in FIG. **1**.

As shown in the figure, the television broadcasting system in this embodiment is configured of a transmitting equipment **101** and a receiving equipment **102**.

The transmitting equipment **101** transmits broadcast information, while the receiving equipment **102** accepts broadcast information and displays a broadcast content. The broadcasting of the broadcast information from the transmitting equipment **101** may be either wireless broadcasting or wire broadcasting. In other words, it is not restricted to conventional television broadcasting by wireless, but it may well be broadcasting based on so-called cable television or the like.

The transmitting equipment **101** includes a plurality of input devices **103**, a signal synthesizer/encoder **104**, a transmission module **105**, a program memory **106** and a transmission controller **107**.

The receiving equipment **102** includes a reception module **108**, a signal separator **109**, a decoder **110**, a display unit **111**, a received signal memory **112**, a user operation input unit **113** and a reception controller **114**.

The constituents of the transmitting equipment **101** function as stated below.

Each of the input devices **103** accepts into the transmitting equipment **101**, broadcast content information to-be-broadcast such as text, a still picture, motion pictures or voice.

Control information items for respective broadcasting channels are kept stored in the program memory **106**. As will be described later, the control information serves to control the broadcast content of the corresponding broadcasting channel.

The signal encoder/synthesizer **104** encodes the respective broadcast content information items accepted by the plurality of input devices **103**. In addition, it accepts the corresponding control information items stored in the program memory **106** and encodes them. On this occasion, it affixes parity error correction codes to the control programs of the control information items in order to facilitate error corrections on the receiving side.

Subsequently, the signal encoder/synthesizer **104** subjects the encoded broadcast content information items to time-division multiplexing operations for every broadcasting channel and sends the resulting multiplexed signals to the transmission module **105**. In addition, it subjects the encoded control information items to time-division multiplexing together with the control information of other broadcasting channels and sends the resulting multiplexed signals to the transmission module **105**.

The transmission module **105** modulates the broadcast content information items subjected to the time-division multiplexing for every broadcasting channel by the signal encoder/synthesizer **104**, at a frequency specified for every broadcasting channel, and it transmits the resulting modulated signals. In addition, it modulates the control information items subjected to the time-division multiplexing, at a specified frequency, and it transmits the resulting modulated signals.

Further, the transmission controller **107** controls the operations of the other constituents included in the transmitting equipment **101**.

Here, the relationships between the motion picture information and the control information which are transmitted from the transmitting equipment **101** are as illustrated in FIG. **2**. The example shown in FIG. **2** corresponds to a case where the content broadcast information items are motion pictures.

Referring to the figure, numerals **200**, **210** and **220** indicate the broadcasting channels each of which contains the broadcast content information items subjected to the time-division multiplexing. As seen from the figure, the broadcasting channel **200** (program channel #1) contains three motion pictures **201**, **202** and **203** subjected to the time-division multiplexing; the broadcasting channel **210** (program channel #2) contains two motion pictures **211** and **212**; and the broadcasting channel **220** (program channel #3) contains four motion pictures **221**, **222**, **223** and **224**.

The other broadcasting channel **230** (a control channel) contains control information items **231**, **232** and **233** which control the broadcast contents concerning the broadcasting channels **200**, **210** and **220**, respectively, and which have been subjected to the time-division multiplexing.

In the broadcasting channel **230**, the control information items **231**, **232** and **233** have been respectively subjected to the time-division multiplexing in a predetermined sequence, and they bear synchronizing flags for specifying the positions of the individual control information signals. Incidentally, the control information is repeatedly broadcast at certain regular intervals as long as it is valid. This is based on the fact that the reception of the program channel is sometimes started midway through a broadcast program.

Hereinbelow, the broadcasting channel which contains the control information items subjected to the time-division multiplexing shall be called the "control channel", while the broadcasting channel which contains the broadcast content information items subjected to the time-division multiplexing shall be called the "program channel".

Next, the functions of the constituents of the receiving equipment **102** will be stated.

The user operation input unit **113** accepts the viewer's instructions for the receiving equipment **102**. It is now assumed that any program channel desired to be viewed is selected as the viewer's instruction. Here, the viewer is only allowed to select any of the broadcasting channels except the control channel, that is, any of the program channels.

The reception module **108** receives and demodulates the control channel transmitted from the transmitting equipment **101**.

The signal separator **109** separates or demultiplexes the time-division-multiplexed control information items contained in the control channel demodulated by the reception module **108**, samples the control information concerning the selected program channel on the basis of the synchronizing flags, and decodes the sampled control information. In the signal separator **109**, the parity codes affixed in relation to the control signals are checked, and any errors are corrected.

The reception controller **114** sets the reception module **108**, signal separator **109** and decoder **110** in accordance with the decoded control information.

The reception module **108** receives and demodulates the selected program channel in accordance with set contents afforded from the reception controller **114**.

The signal separator **109** separates or demultiplexes the broadcast content information items contained in the demodulated program channel, and delivers any of the separated or demultiplexed broadcast content information items to the decoder **110** in accordance with the set contents afforded from the reception controller **114**.

The decoder **110** decodes the video signals of the broadcast content information in accordance with the set contents afforded from the reception controller **114**. In this embodiment, the decoder **110** is constructed of a DSP (Digital Signal Processor). This decoder **110** runs the set decoding program afforded from the reception controller **114**.

The display unit **111** accepts the decoded signals of the broadcast content information from the decoder **110**, and displays them.

Next, the contents of the-control information used in this embodiment will be explained. The control information is generated for each of the broadcast programs which are televised by the program channel.

FIG. **3** lists the contents of the control information. The illustrated example is the control information concerning the program channel in which all the broadcast content information items subjected to the time-division multiplexing are motion picture data.

As shown in the figure, the control information **300** is formed of a program ID **310**, picture or video information **320**, communication information **330** and a controlling program **340**.

The program ID **310** is a peculiar identification No. which is affixed to every control information for each broadcast program to-be-televised.

The picture or video information **320** serves to notify the reception controller **114** of the picture which is transmitted by the program channel corresponding to the control information **300**.

The video information **320** consists of a picture size **321**, the numbers of picture and frames **322**, a pixel composition **323** and a pixel arrayal **324**.

The picture size **321** denotes the numbers of pixels in the height and width of the picture. The numbers of pictures and frames **322** indicate the frame rate of the picture per second, and the number of pictures multiplexed in the corresponding program channel.

The pixel composition **323** indicates the number of bits which express each of the R, G and B components of one pixel. In the example shown in FIG. **3**, the number of bits is set to 8 (256 gradations).

The pixel arrayal **324** indicates how the information items of the respective color components are stored in the motion picture data. In the example shown in FIG. **3**, the respective color components are stored in single-image units in the order of the image of the component R, that of the component G and that of the component B.

The communication information **330** consists of a communication system **331**, the number of bits **332** and a synchronizing frame signal **333**.

The communication system **331** serves to notify the reception controller **114** of the communication system of the program channel corresponding to the control information **300**. In the illustrated example, this item **331** indicates that the corresponding program channel adopts pulse-code frequency modulation (PCM/FM) as its communication system.

Besides, the number of bits **332** indicates the bit length of the data. In the illustrated example, it is set to 8. The synchronizing frame signal **333** indicates a data value which is used for a synchronizing frame serving as the reference of the positions of the motion picture data signals in the program channel. In the illustrated example, the data value of the synchronizing frame is set at OXFFFFFFFF.

The controlling program **340** is a program which is loaded in the reception controller **114**, and which serves to decode the motion picture of the selected program channel and to offer several services.

This controlling program **340** consists of a control program **341**, a decoding program **342** and interactual image data **343**.

The control program **341** offers several services in relation to the program channel to which the control information **300** corresponds.

The picture decoding program **342** serves to decode the video or picture information which has been encoded and transmitted. In the illustrated example, a run-length decoding program is stored.

The dialog or menu image data **343** is the data of an image which the control program **341** uses in order to offer the services to the viewer.

In this manner, the transmitting equipment **101** enters into the control information **300** the information items which are necessary for reproducing the transmitted broadcast content information and the programs which serve to present the broadcast content information.

The first operating example of the television broadcasting system according to this embodiment will be explained below.

Now, let's consider a program in which a kitchen cookery situation simultaneously photographed by a plurality of cameras is televised.

FIG. **4** illustrates the circumstances of such a program broadcast.

First, operations on the side of the transmitting equipment **101** will be explained.

Referring to FIG. **4**, input devices #1, #2 and #3 (**401**, **402** and **403**) installed in the transmitting equipment **101** pick up respectively the image of hands, that of a knife blade and that of the whole situation. A picture taken by the input device #1 shall be called the "picture #1", a picture taken by the input device #2 the "picture #2", and a picture taken by the input device #3 the "picture #3".

In the transmitting equipment **101**, the signal synthesizer/encoder **104** operates so that the photographed pictures are digitally sampled, that the sampled data items are turned into compressed codes every frame by the run length method, and that the picture or video data items after the data compression are arrayed in frame unit successively in the order of the picture #1, the picture #2 and the picture #3 and are subjected to time-division multiplexing. Subsequently, the transmission module **105** modulates the multiplexed signals at a frequency allotted to a program channel **404** and transmits the modulated signals over the program channel **404**. Incidentally, alternative principal systems for encoding pictures include systems based on the DCT (Discrete Cosine Transform). In this embodiment, the sampled picture data may well be turned into compressed codes by the DCT system. In the case of employing the DCT system for the data compression, the picture decoding program of the control information becomes a program which executes the inverse DCT.

In addition, the control information for controlling the pictures #1, #2 and #3 of the program channel **404** in the receiving equipment **102** is fetched from the program memory **106** into the signal synthesizer/encoder **104** and is subjected to time-division multiplexing with control information items concerning program channels other than the program channel **404**. Subsequently, the transmission module **105** modulates the multiplexed control information items and transmits the modulated signals over a control channel.

Here, the control information concerning the program channel **404** contains as the control program **341** a program which allows the viewer to select a picture to-be-displayed from among the pictures taken by the three cameras.

Next, operations on the side of the receiving equipment **102** which receives the program channel **404** will be explained along flow charts illustrated in FIGS. **5** and **6**.

Upon the start of reception, the reception controller **114** first confirms a program channel to-be-received (step **502**). It loads the program ID (**310** in FIG. **3**) in the control information (**300**) concerning the program channel **404** as decoded by the signal separator or demultiplexor **109** (step **503**), and it compares the current program ID with the program ID of the control information loaded the previous time (step **504**). On condition that the program ID's are different, the current control information is loaded in the reception controller **114** as new control information (step **505**). After having loaded the control information, the reception controller **114** executes the control program (**341**) contained in the control information (step **506**). A step **501** signifies that the above processing is iterated until the end of the reception.

The flow chart of the control program (**341** in FIG. **3**) is illustrated in FIG. **6**.

As shown in the figure, the control program proceeds as stated below.

First, the reception controller **114** sets the reception module **108**, signal separator **109** and decoder **110** in accordance with the received control information **300** (step **601**). Specifically, the communication information **330** contained in the control information **300** is sent to the reception module

108. The reception module **108** demodulates the data items of the program channel **404** in succession on the basis of the sent communication information **330**. Then, it sends the demodulated data to the signal separator or demultiplexor **109**. Further, the reception controller **114** sends the picture or video information **320** to the signal separator **109**. The signal separator **109** separates or demultiplexes the demodulated data of the program channel **404** into the data of the picture #1, that of the picture #2 and that of the picture #3 on the basis of the sent picture information **320** and delivers any of the separated picture data items to the decoder **110** in accordance with the command of the reception controller **114**. It is now assumed that, at the start of the reception, the data of the picture **441** is delivered to the decoder **110** as a default picture (step **602**). Hereinbelow, the picture based on the data of the picture **441** shall be called the "image #1", the picture based on the data of the picture #2 the "image #2", and the picture based on the data of the picture #3 the "image #3". Still further, the reception controller **114** sends the picture decoding program **342** to the decoder **110**. The decoder **110** executes the sent program **342**, thereby decoding the picture or video data accepted from the signal separator **109** and displaying the decoded data on the display unit **111**.

At the next step, those image data items of the interactual image data **343** which are designated in the control program **341** are displayed in superposition on the image displayed on the display unit **111** (step **603**). As a result, a user selection menu as shown at numeral **405** in FIG. **4** is displayed at the lower stage of the screen of the display unit **111**. The user selection menu **405** allows the user or viewer to select the picture which is to be displayed on the display unit **111**.

Subsequently, the ensuing processing is iterated for every picture frame (step **604**).

In a case where the viewer has given an instruction in conformity with the user selection menu **405** (step **607**), the reception controller **114** commands the signal separator or demultiplexor **109** to change-over the output thereof to the instructed picture data. Then, the output picture data is decoded by the decoder **110** and is displayed on the display unit **111**. That is, the viewer can select and view any desired picture from among the image of the hands, that of the knife blade and that of the whole cooking scene of the broadcast program (steps **608~611**).

In addition, the reception controller **114** checks for every picture frame, if the program ID of the control information to be received has changed and if the program channel has been changed by the user (steps **605**, **606**). On condition that the program ID of the control information to be received has changed or that the program channel has been changed, the control program is ended and is returned to the first processing step of accepting the control information.

As thus far described, according to this embodiment, the multiplexing degree of the broadcast content information items in each program channel, the encoding rules of the broadcast content information items, etc. can be designated for the receiving equipment by the control information, so that the transmitting side can broadcast in aspects which conform to services to-be-offered. In particular, many sorts of encoding rules can be utilized in such a way that the program for decoding the encoded broadcast content information is transmitted to the receiving equipment by the control information.

Further, the program which controls the displays of the broadcast content information items in each program channel in compliance with the request of the viewer or user can be sent to the receiving side by the control information, so that the viewer can flexibly utilize the broadcast content information as he/she requests.

That is, according to the broadcasting system of this embodiment, the broadcasting can be realized in the presence of only a standard concerning the control information and without the necessity of a unique standard for the program channels.

Incidentally, in the foregoing, the control information concerning the selected program channel in the receiving equipment **102** has been described as being valid for the broadcast content information which is received from commencement of the reception of the control information until the subsequent reception of the different control information. However, video broadcast content information to be controlled by control information may well be specified so as to validate the control information for only the specified broadcast content information. This control aspect can be realized in the following way: The transmitting equipment **101** transmits the control information in which information on the broadcast content information to be controlled by the pertinent control information has been entered beforehand. On the other hand, the receiving equipment **102** temporarily stores the received control information. It validates the stored control information when the broadcast content information to be controlled by the pertinent control information has been received, whereas it invalidates the validated control information when the reception of the broadcast content information to be controlled by the pertinent control information has ended.

Besides, in the foregoing, the broadcasting frequencies of the program channels have been described as being fixed, but they may well be made variable. In this case, the broadcasting equipment **101** transmits control information in which information for designating the broadcasting frequency of the corresponding program channel has been entered beforehand. The reception controller **114** of the receiving equipment **102** commands the reception module **108** to receive the broadcasting frequency, on the basis of the broadcasting frequency information contained in the control information corresponding to the selected program channel.

In addition, although the control channel and the program channels have been described above as being separately provided, control information items may well be transmitted in the state in which they are multiplexed with broadcast content information items in any predetermined program channel. In this case, however, positions for multiplexing the control information items and the broadcasting frequency of the program channel bearing the multiplexed control information items are fixed. The reason therefor is that the receiving equipment **102** is permitted to uniquely receive the control information corresponding to the selected program channel in accordance with the viewer's selection of the program channel.

Yet in addition, in this embodiment, the decoder **110** is constructed using a DSP, and the decoding programs are set, thereby making it possible to decode the broadcast content information items conforming to any desired encoding rules. However, in a case where the sorts of encoding systems for use in broadcasts are limited, dedicated encoding means may well be provided for the respective encoding systems for use in the broadcasts so as to decode the content information items of the broadcasts. In this case, the transmitting equipment **101** enters information for designating the encoding system, into the control information instead of

the picture decoding program. Then, the reception controller **114** of the receiving equipment **102** validates only the decoding means corresponding to the designated encoding system in accordance with the encoding system-designating information.

Now, the second operating example of the broadcasting system according to this embodiment will be described.

In this operating example, broadcast content information items are temporarily stored and are thereafter utilized.

The broadcast content information items are recorded as stated below.

When a program channel to be recorded is set by the viewer, the reception controller **114** commands the received signal memory or recorder **112** to record control information on the set program channel and the data of the program channel in parallel. However, in a case where the received signal recorder **112** cannot store signals in parallel, the control information and the data of the program channel are multiplexed and then recorded, and the recorded signals are demultiplexed and restored into two parallel signals in a playback mode. In a case where the control information has changed in the recording operation, new control information after the change is also recorded. Incidentally, it is assumed that each broadcast content information item in the program channel bears the header of a program name for every program, and that a peculiar title is affixed as a header to every group or set of information items within each program. A video tape deck, a rewritable type optical disk memory, or the like can be employed for the received signal recorder or memory **112**.

The operation of playing back the broadcast content information recorded in the received signal recorder **112** will be explained along a flow chart shown in FIG. **7**.

When the instruction of playback has been afforded from the user operation input unit **113**, the reception controller **114** checks the control information items stored in the received signal recorder **112**, successively in the order in which they have been recorded (step **702**). Upon detecting the control information **300**, the reception controller **114** compares the last program ID **310** of the pertinent control information with the current program ID thereof (step **703**). On condition that both the ID's are different, the reception controller **114** loads the control program **341** from within the control information **300** (step **704**), and it executes the control program **341** (step **705**). A step **701** signifies that the above steps are iterated until the final storage location is reached.

The flow chart of the control program **341** for use in this operating example is illustrated in FIG. **8**.

As shown in the figure, the reception controller **114** having started the run of the control program **341** first sets the contained communication information **330** of the control information **300** in the reception module **108**, the picture or video information **320** in the signal separator or demultiplexor **109** and the picture decoding program **342** the decoder **110** (step **801**).

Subsequently, the reception controller **114** checks if the playback from the received signal memory **112** is currently instructed (step **802**).

When the playback is not instructed, the ordinary processing (refer to FIG. **6**) explained as the first operating example is performed. On the other hand, when the playback is instructed, the relationship of the respective broadcast content information items within the program corresponding to the control information, with the storage locations in the received signal recorder **112** are confirmed on the basis of the headers of the broadcast content information items for every title affixed to this broadcast content information (step **804**).

The ensuing processing is performed until the end of the playback (step **805**).

More specifically, as illustrated in FIG. **10**, a program name **1001** and a playback menu **1000** which correspond to the control information are displayed on the display unit **111** (step **806**). The items of the menu **1000** are the titles **1002~1004** of the respective information items contained in the program, and the next program **1006**. The example shown in FIG. **10** is in the case of playing back the program "News" which contains the information having the title "With me" and the information having the title "Weather forecast". The titles **1002~1004** of the respective information items within the program correspond to the titles affixed to the broadcast content information items.

Subsequently, when the viewer has designated the title of desired information among the playback menu **1000** through the user operation input unit **113** (step **807**), the broadcast content information bearing the corresponding title as the header is played back in compliance with the designation (step **808** or **809**).

In a case where the next program **1006** has been designated, the start position of playback is advanced to the end location of the broadcast content information bearing the name of the current program as the header (step **810**), and the control program is run from the foregoing process for checking the control signals.

Meanwhile, the broadcast content information to which the title designated by the viewer is affixed as the header is played back in accordance with a flow chart illustrated in FIG. **9**.

First, the reception controller **114** erases the display of the menu image shown in FIG. **10** (step **901**). Subsequently, it calculates the initial or foremost storage location and the terminal or last storage location of the broadcast content information which bears the designated title as the header (steps **902**, **903**).

The broadcast content information in a section from the calculated initial location to the calculated terminal location is played back (steps **904**, **905**, **906**, **907**). The broadcast content information played back is decoded by the decoder **110**, and is displayed on the display unit **111**. Herein, the decoder **110** decodes the broadcast content information which has been played back on the basis of the picture decoding program **342** set by the reception controller **114**.

As thus far described, according to this embodiment, only the required information part in the stored programs can be played back.

In the above embodiment, there is also considered a case where the playback menu **1000** contains a plurality of multiplexed programs. In this case, the received signal memory **112** can simultaneously record all the programs which are being broadcast at the same time. Therefore, such a case can be coped with without hindrance.

Now, the third operating example according to this embodiment will be described.

In the third operating example, as illustrated in FIG. **11**, at least one external equipment is connected to the receiving equipment **102** and is controlled.

Referring to FIG. **11**, numeral **1201** indicates an external equipment controller, numeral **1202** an electronic keyboard, numeral **1203** an electronic guitar, numeral **1204** a mixer, and numeral **1205** a loudspeaker.

Each of the electronic keyboard **1202** and the guitar **1203** is an electronic musical instrument which can be controlled through a MIDI (Musical Instrument Digital Interface).

In this operating example, the transmitting equipment **101** separately encodes the sounds of the respective musical instruments being performed, subjects the respective sound codes to time-division multiplexing as broadcast content information items, and transmits the multiplexed information items over a program channel. In addition, control information corresponding to a pertinent program is endowed with a decoding program which decodes the encoded sound of the musical instrument, and MIDI data which is control information for the external musical instrument connected to the receiving equipment **102**. The MIDI data is generated for every part contained in the performance, and is entered into the control information. Besides, a program which accepts the designation of the external musical instrument to be controlled by the MIDI data is entered into the control program **341** contained in the control information **300**. The control information is transmitted so that the receiving equipment **102** can utilize the MIDI data in real time in synchronism with the performance transmitted over the program channel. In addition, the broadcast content information is transmitted in the state in which synchronizing data for the synchronization with the MIDI data is affixed thereto.

On the other hand, when the receiving equipment **102** having selected the pertinent program receives the control information, the reception controller **114** starts the control program **341** and sets the decoding program in the decoder **110**. The decoder **110** decodes the received sound in accordance with the decoding program, so as to synthesize and produce the sounds of the respective musical instruments.

Further, the reception controller **114** commands the display unit **111** to present an image shown in FIG. **12**A. Thus, it indicates that the MIDI data can be utilized in the pertinent program, and it accepts a request to commence utilization of the MIDI data.

If the utilization of the MIDI data is designated, the reception controller **114** presents a menu shown in FIG. **12**B. Thus, it accepts the designation of either an automatic performance or a manual performance and also accepts the for which it is part desired to utilize the MIDI data.

When the automatic performance is designated and the desired part to utilize the MIDI data is designated, the reception controller **114** commands the decoder **110** to produce no sound for the designated part. Then, the MIDI data of the designated part is output to the external equipment controller **1201** in order that the pertinent part may be performed in synchronism with the output sound of the connected electronic musical instrument, on the basis of the synchronizing data affixed to the broadcast content information.

The external equipment controller **1201** sends the received data onto a MIDI bus, and controls the musical instruments so as to produce the sound of the designated part.

On the other hand, when the user designates the manual performance mode in which he/she plays the musical instrument, the reception controller **114** commands the decoder **110** to produce no sound for the designated part, and it ends its processing.

As thus far described, according to this operating example, the user can play his/her electronic musical instrument in time to the transmitted performance.

Incidentally, this embodiment is not restricted to the broadcasting form, but it is quite similarly applicable to picture communications in one-to-one correspondence, such as video telephony.

Besides, in this embodiment, the individual broadcasting channels have been described as being physical channels of different broadcasting frequencies. The system of this embodiment, however, is also applicable to a case where the individual broadcasting channels are logical channels. More specifically, in such a case where all the program channels and the control channel are multiplexed into a single physical channel by, e.g., time-division multiplexing, the following measure may be taken: The position of the control channel and the positions of individual control information items contained in the control channel are fixed. The position of a selected one of the program channels, and broadcast content information contained in the program channel are specified by the control information for the selected channel.

Now, the fourth operating example concerning this embodiment will be described. This operating example consists of a multiplexing equipment in which a plurality of broadcast information items are multiplexed into a single item of broadcast information by the use of the transmitting equipment **101** in the first embodiment. FIG. **13** exemplifies the multiplexing equipment **1301** in the fourth embodiment. Referring to the figure, a signal synthesizer/encoder **104**, a transmission module **105**, a program memory **106** and a transmission controller **107** are the same as in the transmitting equipment **101** of the first embodiment. In the case of the multiplexing equipment **1301**, unlike the case of the transmitting equipment **101**, pictures are not directly input to the signal synthesizer/encoder **104**, but broadcast information items **1303** are respectively turned by reception units **1302** into pictures, which are input to the signal synthesizer/encoder **104**. Thereafter, the signals are synthesized and have control information affixed thereto by the signal synthesizer/encoder **104**, and the resulting information **1304** into which the plurality of information items have been multiplexed is output from the transmission module **105**. Thus, the plurality of broadcasts can be accepted and multiplexed. Moreover, in the case where the recording in the second embodiment is carried out, a number of programs desired by the user can all be recorded even when they are broadcast in different channels at the same time, by way of example.

Furthermore, the installation of the multiplexing equipment **1301** on a video recorder makes it possible to multiplex the plurality of broadcast information items into the single broadcast information and to store the multiplexed broadcast information in a record medium. In a playback mode, required information in the recorded broadcast information can be played back by executing the decoding operation in the foregoing embodiment. In this way, the plurality of broadcast information items can be recorded on the single record medium in this embodiment in contrast to the recording aspect in which only one broadcast information (or program) can be recorded on one record medium.

As set forth above, the present invention can provide a television broadcasting system in which compression systems, multiplexing systems, the selection of pictures by viewers, etc. are rendered flexible in order to offer multifarious services to the viewers.

What is claimed is:

1. A television broadcasting method wherein a transmitting equipment broadcasts a broadcast program picture, while a receiving equipment receives and displays a broadcasted broadcast program picture from said transmitting equipment, said method comprising the steps of:

broadcasting control information by means of said transmitting equipment, said control information including

broadcast system standard information specifying a broadcast system standard for receiving and displaying said broadcast program picture at said receiving equipment;

broadcasting said broadcast program picture in accordance with said broadcast system standard by means of said transmitting equipment;

receiving said control information by means of said receiving equipment; and

displaying said broadcast program picture broadcasted from said transmitting equipment, on a basis of said broadcast system standard specified by said broadcast system standard information included in a received said control information by means of said receiving equipment.

2. A television broadcasting method as defined in claim **1**, wherein said transmitting equipment encodes said broadcast program picture and then broadcasts said broadcast program picture as an encoded broadcast program picture, and includes a decoding program for decoding said encoded broadcast program picture into said broadcast system standard information included in said control information which is broadcasted, and wherein said receiving equipment decodes said encoded broadcast program picture by executing said decoding program in said broadcast system standard information included in said received control information and then displays a decoded broadcast program picture.

3. A television broadcasting method as defined in claim **1**, wherein said transmitting equipment multiplexes a plurality of broadcast program pictures in accordance with a multiplex system and then broadcasts multiplexed broadcast program pictures, and includes multiplex information specifying said multiplex system in said broadcast system standard information for use in separating each of said broadcast program pictures at said receiving equipment,

and wherein said receiving equipment selects a subject broadcast program picture which is to-be-displayed, separates said subject broadcast program picture from said multiplexed broadcast program pictures on a basis of said multiplex system specified by said multiplex information in said broadcast system standard information included in received said control information and displays said subject broadcast program picture which has been separated.

4. A television broadcasting method as defined in claim **1**, wherein said transmitting equipment multiplexes a plurality of broadcast program pictures and then broadcasts multiplexed broadcast program pictures, and includes in said control information content information items, each of which indicates a respective content of said broadcast program pictures, and

wherein said receiving equipment displays said each respective content of said broadcast program pictures multiplexed and broadcasted as indicated by said content information items included in a received said control information, accepts a user selection of a subject broadcast program picture to-be-displayed, separates said subject broadcast program picture in accordance with an accepted said user selection, and displays said subject broadcast program picture which has been separated.

5. A television broadcasting method wherein a transmitting equipment transmits a broadcast program picture, and a receiving equipment receives and displays a transmitted said broadcast program picture from said transmitting equipment, said method comprising the steps of:

transmitting a control program by means of said transmitting equipment, said control program, upon execution at said receiving equipment, allowing for acceptance of user instructions from a user and controlling receiving and displaying of said broadcast program picture at said receiving equipment in accordance with said user instructions in order to support customized use of said broadcast program picture by said user of said receiving equipment; and

receiving and executing said control program at said receiving equipment, and thereby supporting customized use of said broadcast program picture by means of said receiving equipment.

6. A television broadcasting system comprising a transmitting equipment which broadcasts a broadcast program picture, and at least one receiving equipment which receives and displays a broadcasted broadcast program picture from said transmitting equipment;

wherein said transmitting equipment comprising a control information transmission means to broadcast control information in accordance with a predetermined format, said broadcast control information including a broadcast system standard information specifying a broadcast system standard for receiving and displaying said broadcast program picture at said receiving equipment, and broadcast program picture transmission means for broadcasting said broadcast program picture in accordance with said broadcast system standard; and

wherein said receiving equipment comprising control information reception means to receive said broadcast control information in accordance with said predetermined manner, and broadcast program picture processing means to receive and display said broadcast program picture broadcasted from said transmitting equipment, in accordance with said broadcast system standard specified by said broadcast system standard information included in a received said broadcast control information.

7. A television broadcasting system as defined in claim **6**, wherein said broadcast program picture processing means of said receiving equipment includes a memory means to store therein a received said broadcast program picture and a received said broadcast control information, and further comprises a playback means to play back said broadcast program picture stored in said memory means, in accordance with a user instruction, and display means to display a played-back said broadcast program picture in accordance with a stored said broadcast control information.

8. A television broadcasting system as defined in claim **6**, wherein said broadcast program picture transmission means of said transmitting equipment encodes said broadcast program picture and then broadcasts an encoded said broadcast program picture, and said control information transmission means of said transmitting equipment includes a decoding program for decoding an encoded said broadcast program picture in said broadcast control information which is broadcasted,

and wherein said broadcast program picture processing means of said receiving equipment includes a decoder which decodes a received said broadcast program picture by executing said program included in a received said broadcast control information, and a display unit which displays said broadcast program picture decoded by said decoder.

9. A television broadcasting system as defined in claim **7**, wherein said broadcast program picture transmission means of said transmitting equipment multiplexes a plurality of

broadcast program pictures using a multiplex system and then broadcasts multiplexed said broadcast program pictures, and said control information transmission means of said transmitting equipment includes multiplex information specifying said multiplex system in said broadcast system standard information included in said broadcast control information which is broadcasted for use in separating each broadcast program picture of said broadcast program pictures at said receiving equipment;

and wherein said broadcast program picture processing means of said receiving equipment includes a separator which selects a subject broadcast program picture to-be-displayed and separates said subject broadcast program picture from said multiplexed broadcast program pictures on a basis of said multiplex system as specified by said multiplex information in said broadcast system standard information included in said received broadcast control information, and a display unit which displays said subject broadcast program picture separated by said separator.

10. A television broadcasting system as defined in claim **9**, wherein said transmitting equipment includes a plurality of reception units which receive a plurality of broadcast information items, respectively, and a received said broadcast information items are multiplexed into multiplexed said broadcast program pictures which are to be transmitted by said transmitting equipment.

11. A television transmission equipment comprising an input means for inputting a plurality of broadcast program picture items, a processing means for converting a plurality of input said broadcast program picture items into a signal for broadcast in accordance with a predetermined broadcast system standard, and transmission means for broadcasting said signal and control information specifying said predetermined broadcast system standard.

12. A television transmission equipment as defined in claim **11**, wherein said input means inputs a plurality of broadcast program picture items, said processing means multiplexes said plurality of input said broadcast program picture item in accordance with a multiplex system, and said transmission means broadcasts a multiplexed said broadcast program picture items and multiplex control information specifying said multiplex system.

13. A television reception equipment comprising a reception means for receiving a broadcast program picture and control information which are broadcasted in accordance with a predetermined format, said control information specifying a broadcast system standard, and a broadcast content processing means for controlling and displaying said broadcast program picture in accordance with said broadcast system standard specified by said control information received by said reception means.

14. A television reception equipment as defined in claim **13**, wherein said broadcast program picture to be received by said reception means is an encoded said broadcast program picture, and said control information to be received by said reception means includes decoding information for specifying a decoding system for an encoded said broadcast program picture, and wherein said broadcast content processing means includes a control means for specifying a decoding system for said broadcast program picture in accordance with said control information received by said reception means, a decoder means for decoding said broadcast program picture in accordance with said decoding system specified by said control means, and display means for displaying said broadcast program picture decoded by said decoder means.

15. A television reception equipment as defined in claim **13**, wherein said reception means receives a plurality of broadcast program pictures multiplexed in a time division manner, and said control information includes a multiplex information item for specifying a time-division multiplexing system of said time-division multiplexed broadcast program pictures, and wherein said broadcast content processing means includes a control means for specifying said time-division multiplexing system in accordance with said multiplex information item included in said control information received by said reception means, a separation means for selecting a subject broadcast program picture to-be-displayed and separating said subject broadcast program picture in accordance with said time-division multiplexing system specified by said control means, and display means for displaying a subject broadcast program picture separated by said separation means.

16. A television reception equipment as defined in claim **15**, wherein said control information further includes content information items indicating contents of said broadcast program pictures multiplexed and broadcasted, and wherein said television reception equipment further comprises a control means and a display means, and said control means operates to display said contents of said plurality of broadcast program pictures indicated by said content information items on said display means on a basis of a received said control information, operates to accept selection of a subject broadcast program picture to-be-displayed, and operates to display a selected said subject broadcast program picture on said display means.

17. A television reception equipment comprising a first reception means for receiving control information including frequency broadcast system standard data indicating each frequency channel of a plurality of broadcast program pictures which are subjected to frequency multiplexing and broadcasted, a second reception means for receiving at least one of frequency-multiplexed and broadcasted said plurality of broadcast program pictures in accordance with said control information and frequency broadcast system standard data received by said first reception means, and a display means for displaying a subject broadcast program picture received by said second reception means.

18. A television broadcasting method as claimed in claim **1**, wherein said transmitting equipment encodes said broadcast program picture in accordance with a coding system and then broadcasts an encoded said broadcast program picture, and includes coding information specifying said coding system of said encoded said broadcast program picture into said broadcast system standard information included in said control information which is broadcasted, and wherein said receiving equipment decodes a received said broadcast program picture, on a basis of said coding system specified by said coding information in said broadcast system standard information included in said received said control information and then displays a decoded said broadcast program picture.

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(54) **DIGITAL BROADCAST RECEIVER UNIT**

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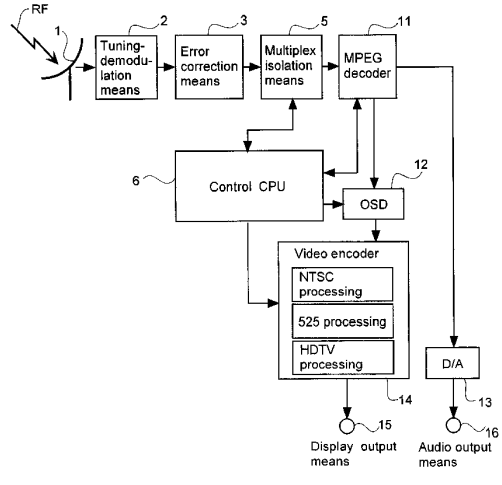
Assistant Examiner—Paulos Natnael
(74) *Attorney, Agent, or Firm*—Antonelli, Terry, Stout & Kraus LLP

(57) **ABSTRACT**

A digital broadcast receiver unit for determining the scanning method of the video signal of the selected program when signals multiplexed through a plurality of different scanning methods are received, processing these video signals by an appropriate video signal processor constituting a video encoder, and then outputting the result. This digital broadcast receiver unit includes a demodulator to tune in the channel of the received signal and perform demodulation, a multiplex isolator to isolate the audio, video and other types of data coded from the multiplex signals output from the demodulator, a decoder to decode the video signal and audio signal from the multiplex isolator, a plurality of video processors performing respectively different corresponding scanning methods and connected to an output of the decoder, an output selector to select from among outputs from the plurality of video processors, and a controller to control the output selector and determine the scanning method of the video signal of the selected program and also perform the appropriate processing based on the scanning method for the selected video signal.

27 Claims, 11 Drawing Sheets



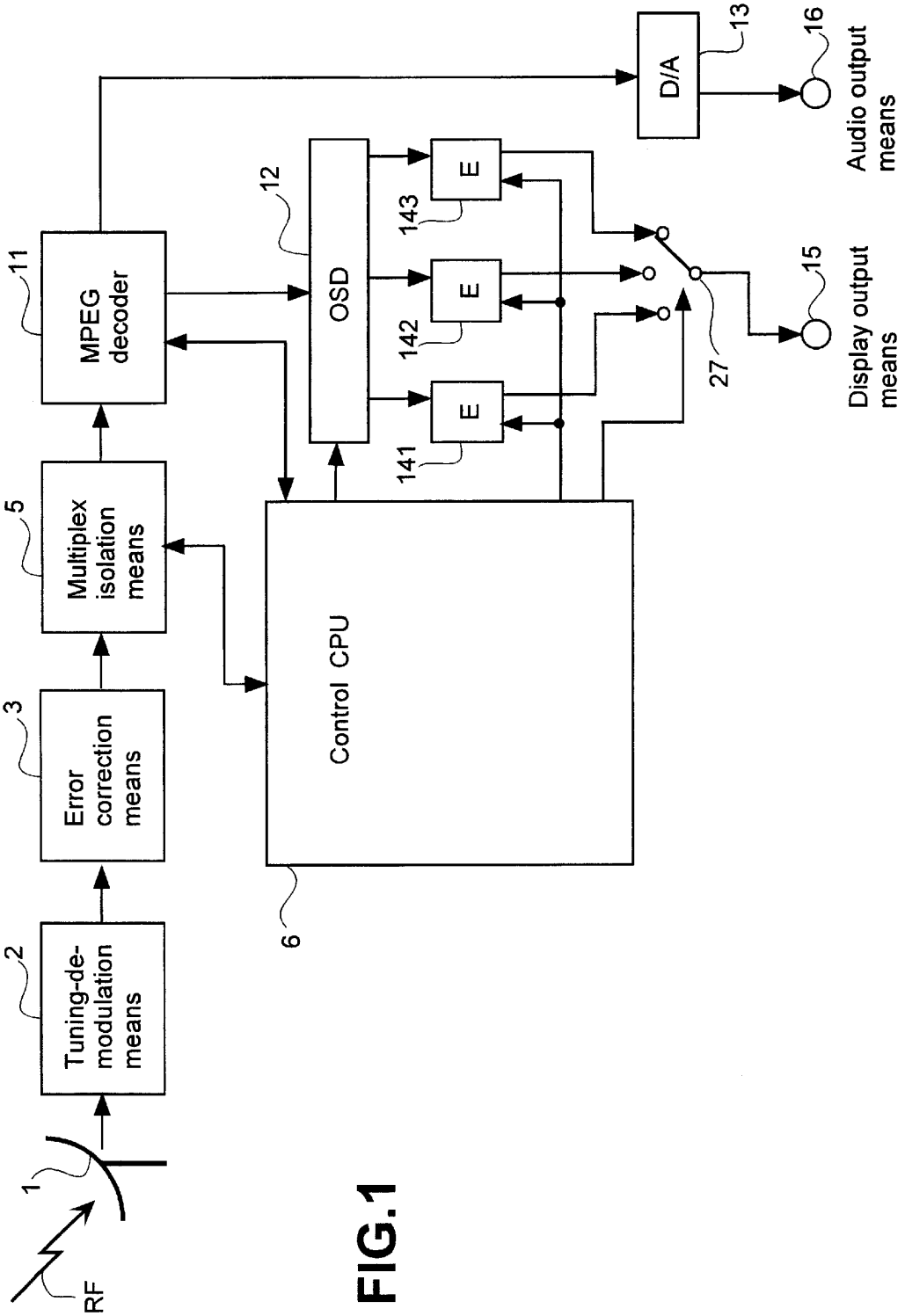

RF
1
Tuning-de-modulation means
2
Error correction means
3
Multiplex isolation means
5
MPEG decoder
11
OSD
12
E
143
E
142
E
141
Control CPU
6
D/A
13
Audio output means
16
Display output means
15
27

FIG.1

FIG.2A

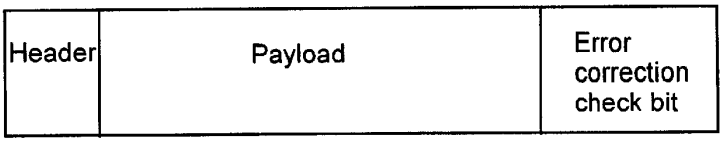


FIG.2B

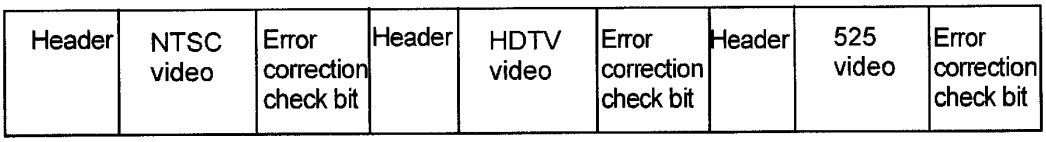


FIG.2C

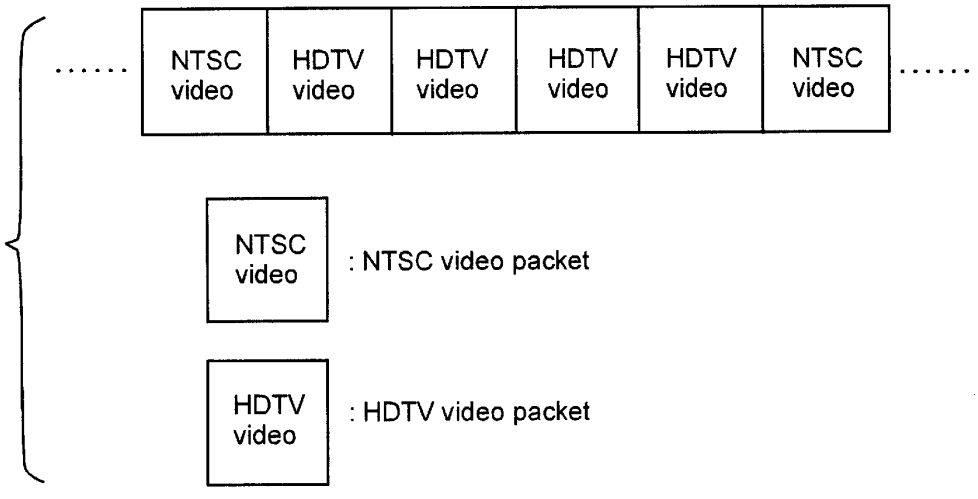


FIG.3

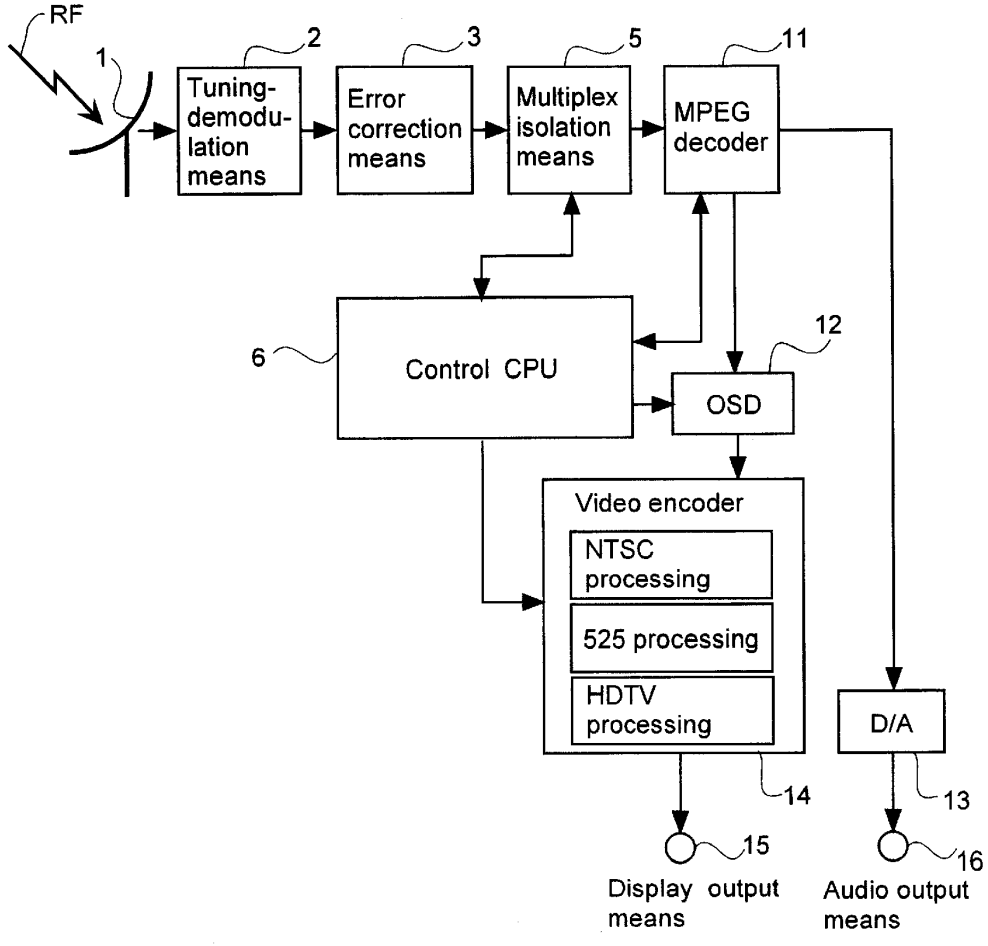


FIG.4A

Header	NTSC video	Error correction check bit	Header	HDTV video	Error correction check bit	Header	Scanning method data	Error correction check bit

FIG.4B

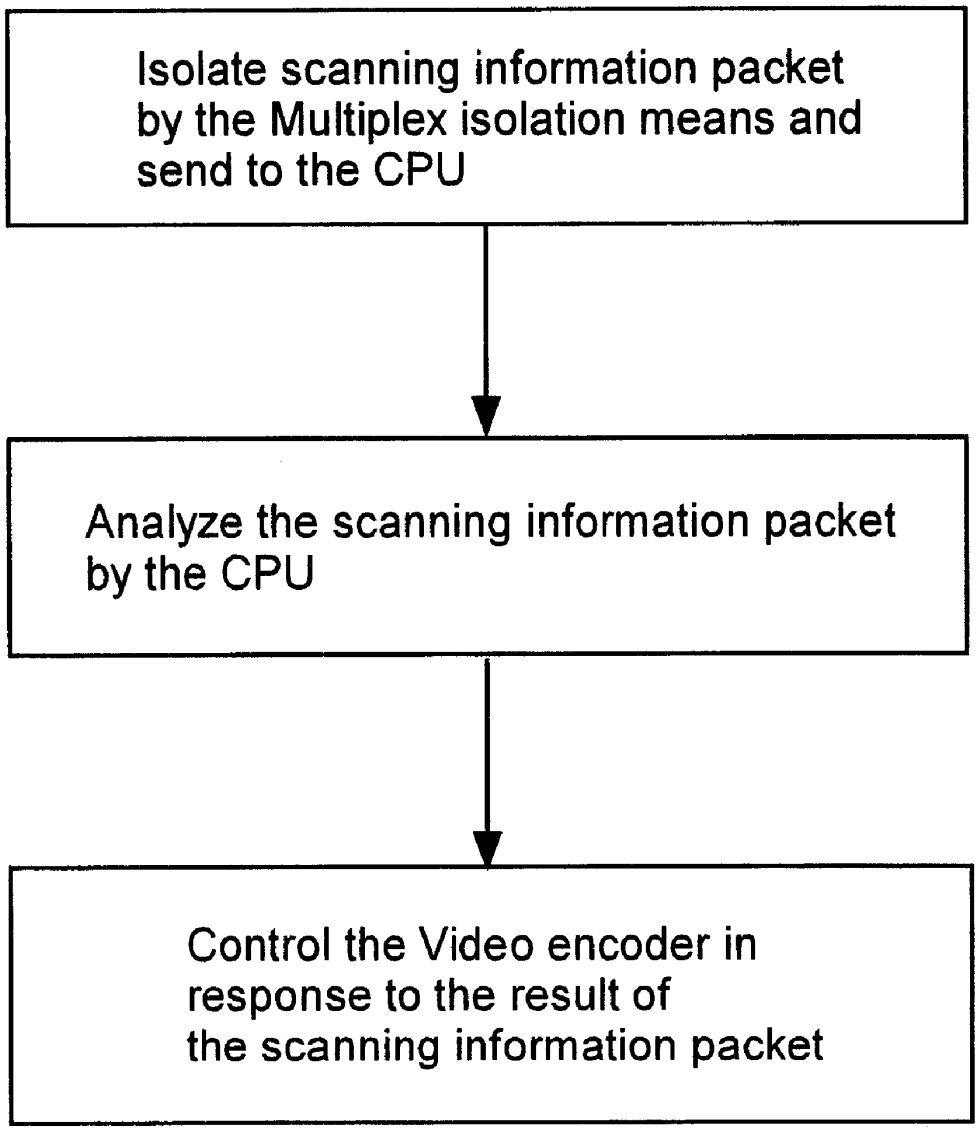

Isolate scanning information packet by the Multiplex isolation means and send to the CPU
Analyze the scanning information packet by the CPU
Control the Video encoder in response to the result of the scanning information packet

FIG.5

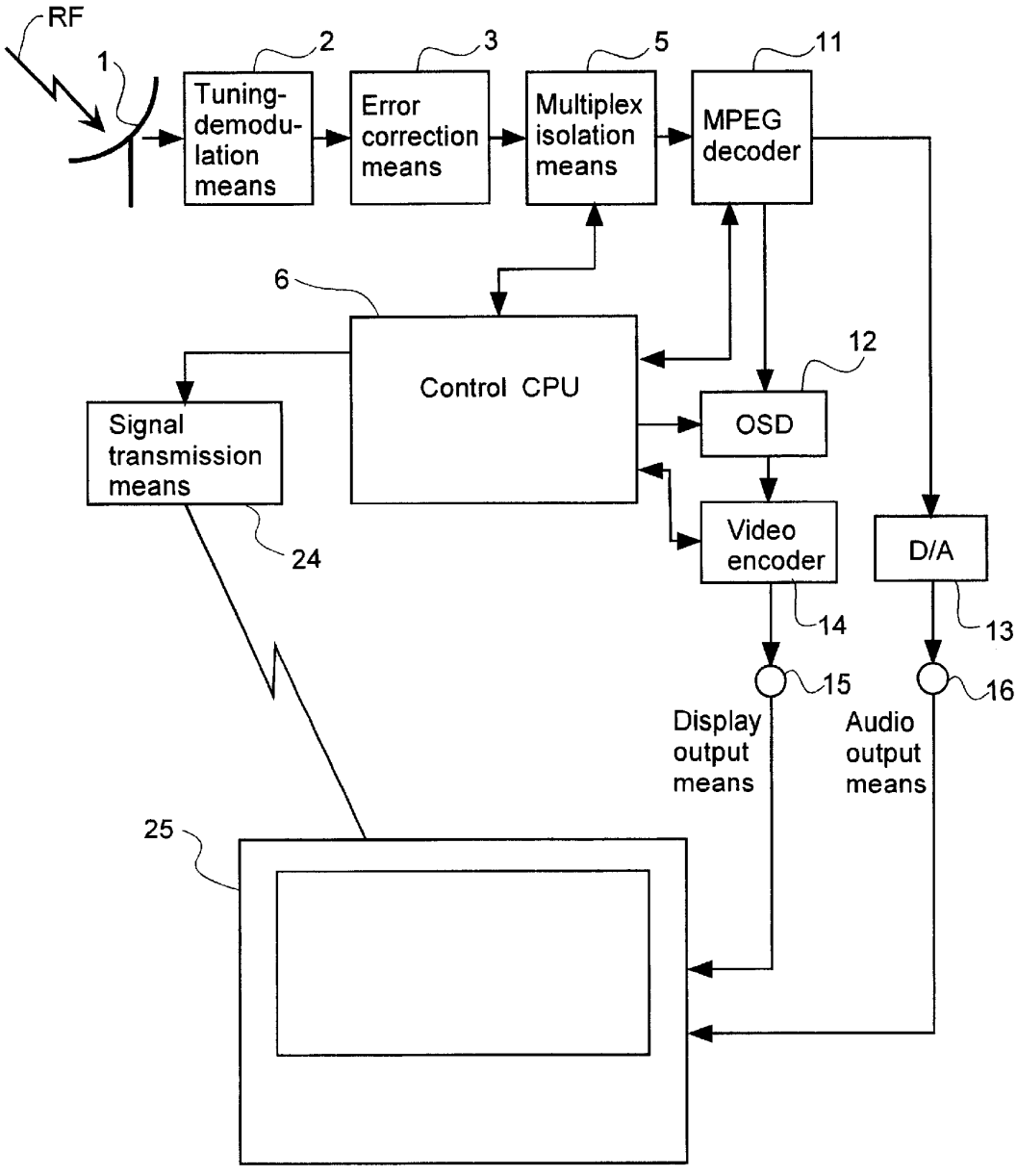

RF
1
2
Tuning-demodulation means
3
Error correction means
5
Multiplex isolation means
11
MPEG decoder
6
Control CPU
12
OSD
Signal transmission means
24
Video encoder
D/A
14
13
15
16
Display output means
Audio output means
25

FIG.6

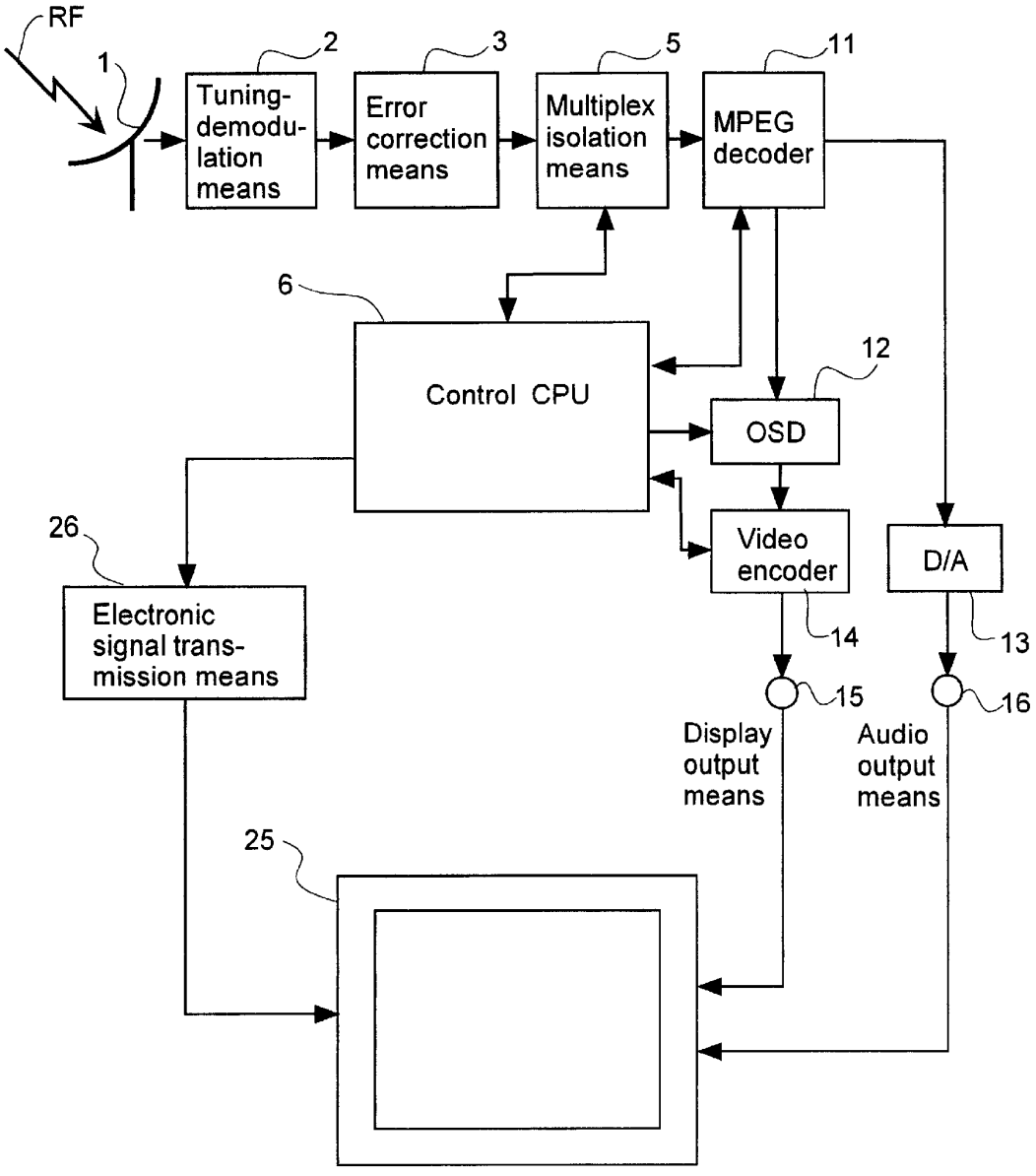

RF
1
2
Tuning-demodulation means
3
Error correction means
5
Multiplex isolation means
11
MPEG decoder
6
Control CPU
12
OSD
Video encoder
D/A
26
Electronic signal transmission means
14
13
15
16
Display output means
Audio output means
25

FIG.7

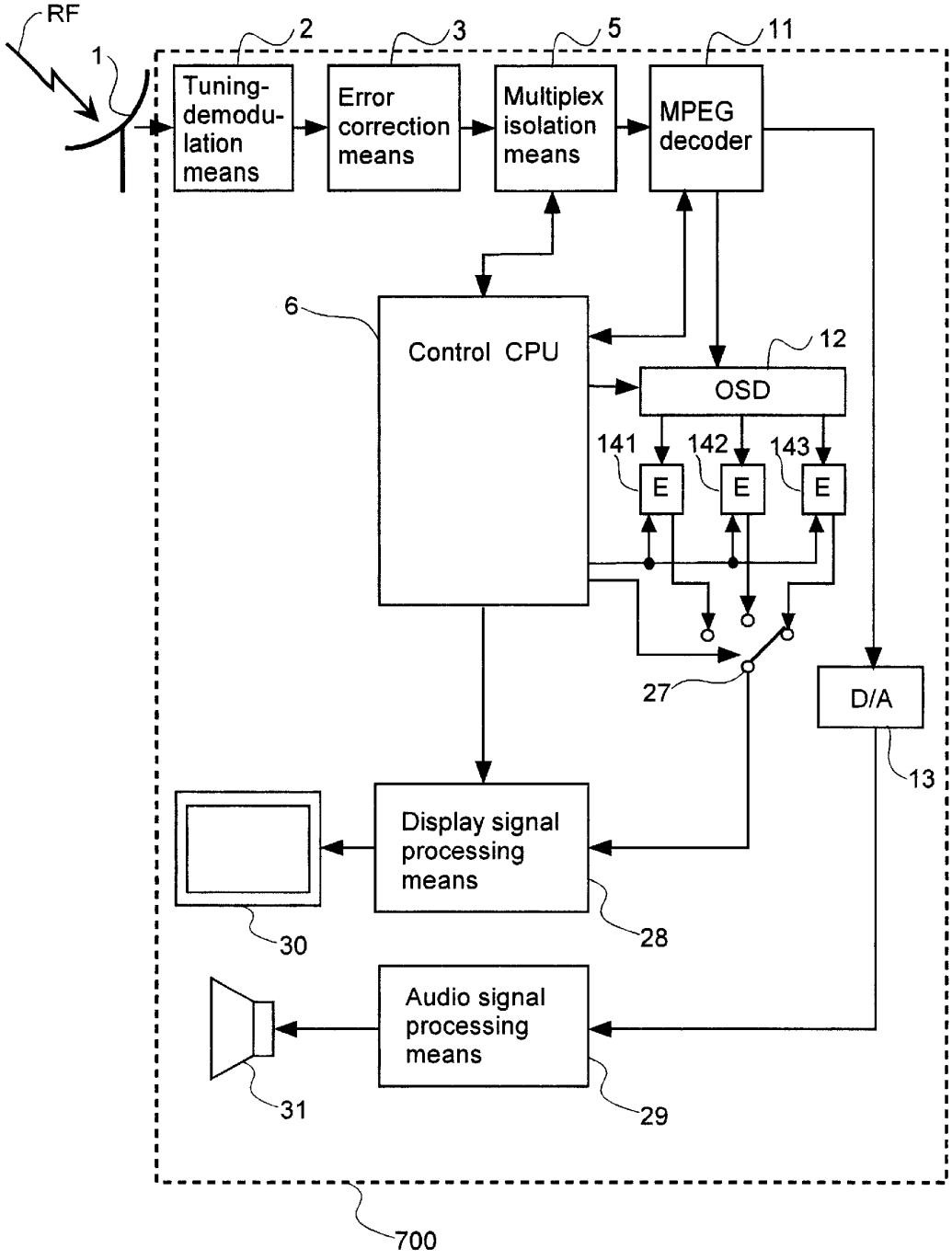

RF
1
2
3
5
11
Tuning-demodulation means
Error correction means
Multiplex isolation means
MPEG decoder
6
Control CPU
12
OSD
141
142
143
E
E
E
27
D/A
13
Display signal processing means
28
30
Audio signal processing means
29
31
700

FIG.8

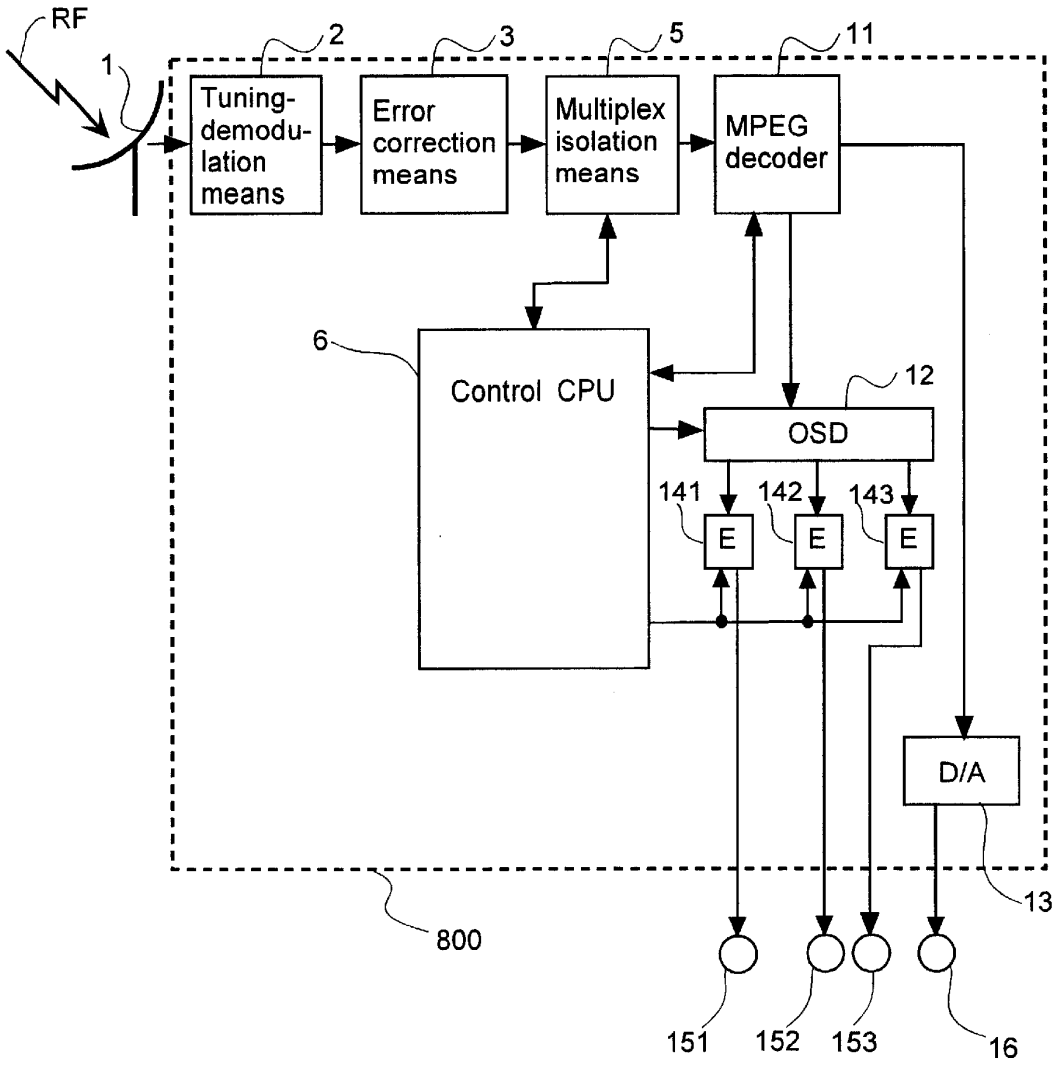

RF
1
2
3
5
11
Tuning-demodulation means
Error correction means
Multiplex isolation means
MPEG decoder
6
Control CPU
12
OSD
141
142
143
E
E
E
D/A
13
800
151
152
153
16

FIG.9

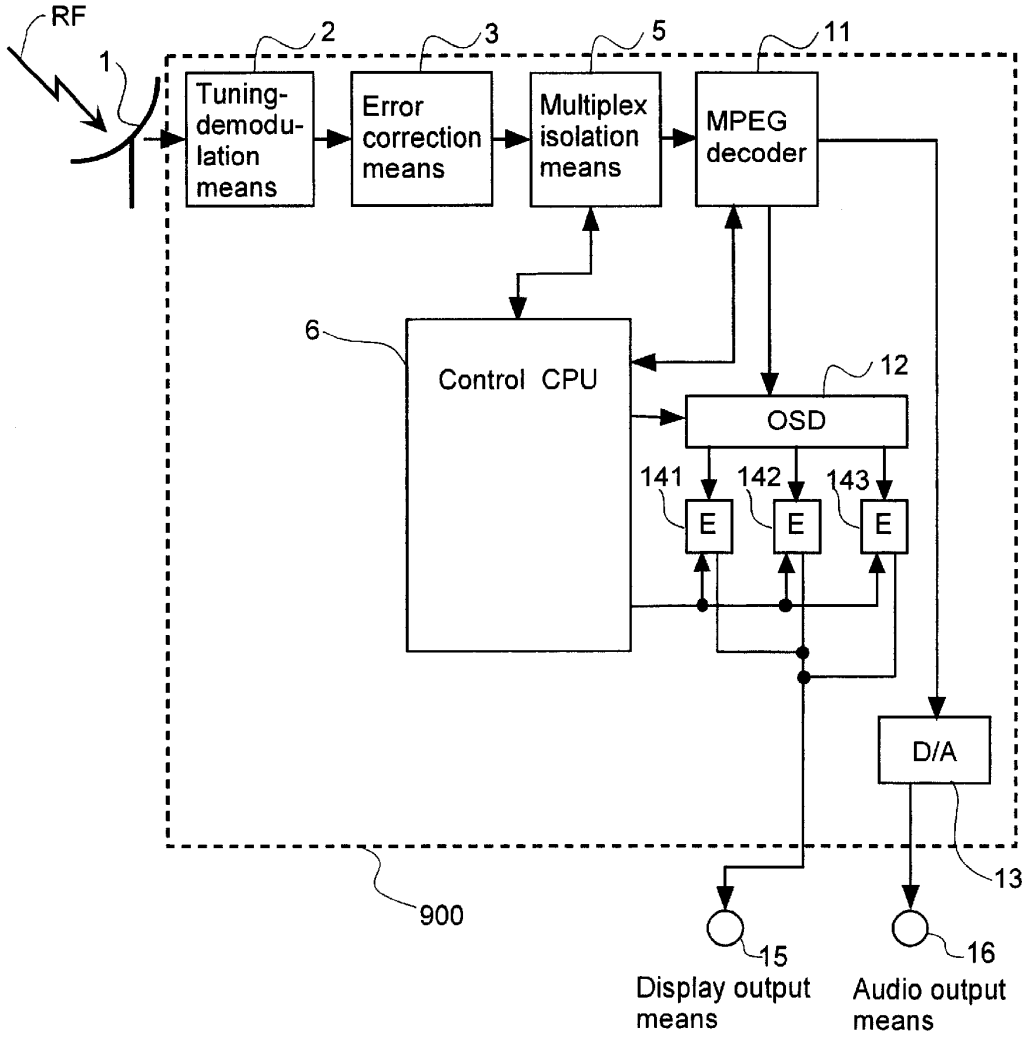

RF
1
2
3
5
11
Tuning-demodulation means
Error correction means
Multiplex isolation means
MPEG decoder
6
Control CPU
12
OSD
141
142
143
E
E
E
D/A
13
900
15
16
Display output means
Audio output means

FIG.10

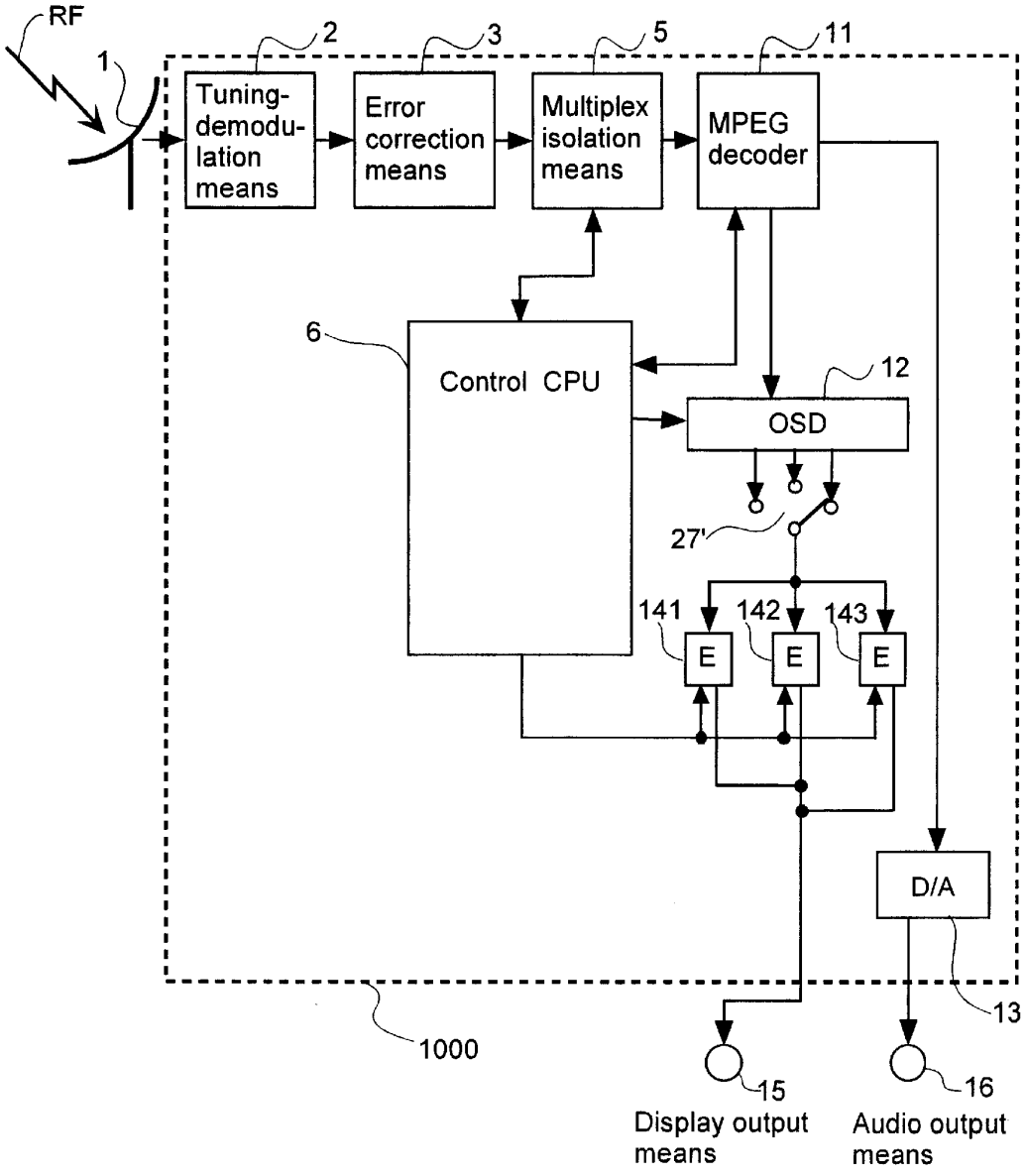
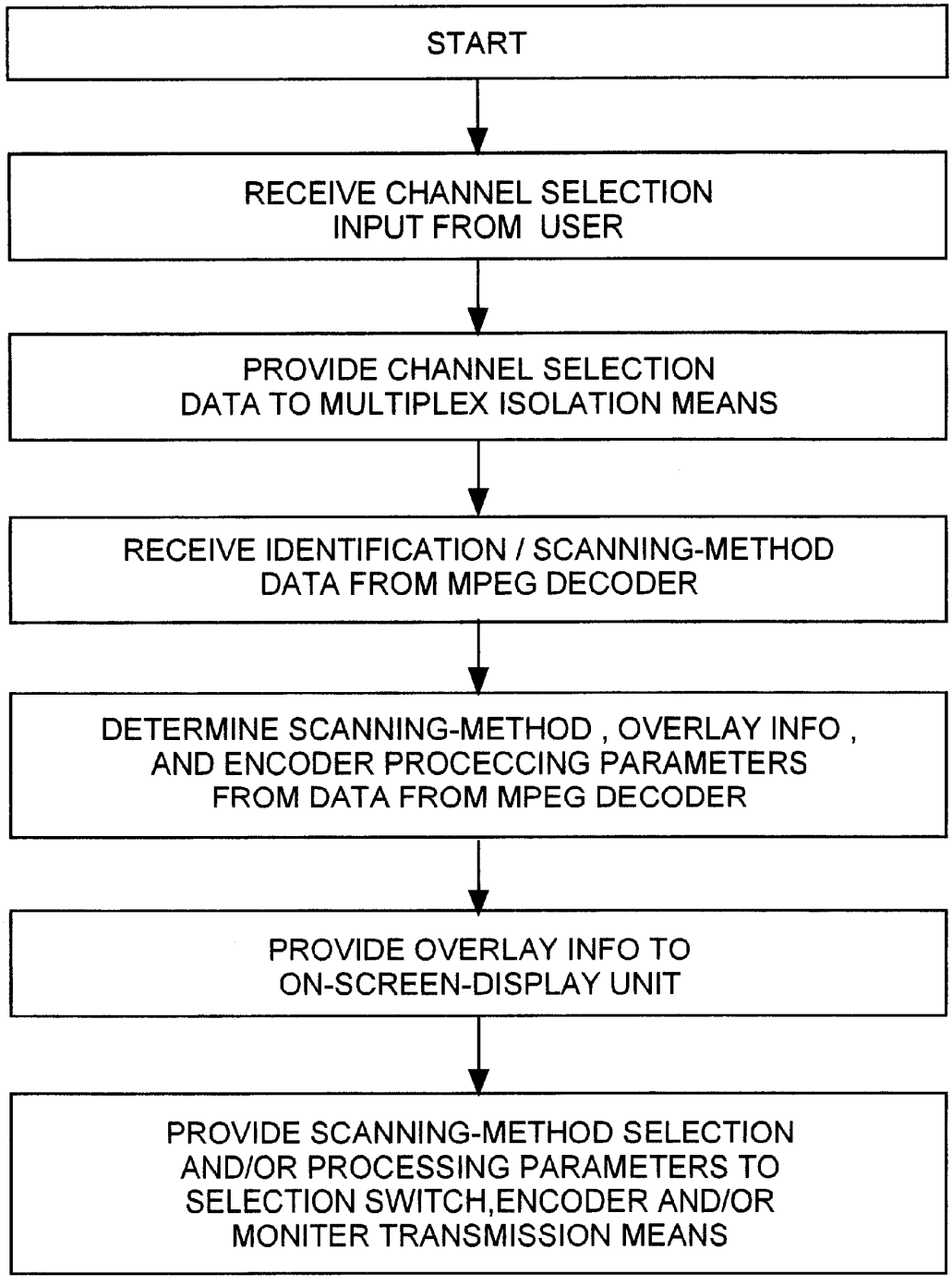

RF
1
2
3
5
11
Tuning-demodulation means
Error correction means
Multiplex isolation means
MPEG decoder
6
Control CPU
12
OSD
27'
141
142
143
E
E
E
D/A
13
1000
15
16
Display output means
Audio output means

FIG.11


START
RECEIVE CHANNEL SELECTION INPUT FROM USER
PROVIDE CHANNEL SELECTION DATA TO MULTIPLEX ISOLATION MEANS
RECEIVE IDENTIFICATION / SCANNING-METHOD DATA FROM MPEG DECODER
DETERMINE SCANNING-METHOD , OVERLAY INFO , AND ENCODER PROCECCING PARAMETERS FROM DATA FROM MPEG DECODER
PROVIDE OVERLAY INFO TO ON-SCREEN-DISPLAY UNIT
PROVIDE SCANNING-METHOD SELECTION AND/OR PROCESSING PARAMETERS TO SELECTION SWITCH,ENCODER AND/OR MONITER TRANSMISSION MEANS

DIGITAL BROADCAST RECEIVER UNIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a digital broadcast receiver unit, and in particular, relates to a digital broadcast receiver unit capable of receiving, in one stream, multiplex video signals formatted according to a plurality of differing scanning methods.

2. Description of Related Art

In digital transmission technology, in addition to video and audio signals, all kinds of information can be multiplexed and broadcast over one common carrier wave, i.e., multi-channel broadcasts utilizing this technology have already commenced. By utilizing this digital transmission technology, video signals for different scanning methods can be coded, multiplexed (i.e., placed on one common carrier wave) and then broadcast.

In contrast, in related art analog broadcast receivers, television receivers are able to receive transmissions from a plurality of analog broadcast systems. In analog broadcasting, however, different kinds of information cannot be multiplexed (or placed together on the same carrier wave) so that the received video signal itself must be analyzed to determine the scanning method. When receiving different video signals having a plurality of scanning systems in the above mentioned related art analog broadcasts, not only was a custom identification means required to analyze and process the received video signal itself, but in order to identify the video signal, video signal processing circuits had to be operated whose operation was not actually necessary.

In contrast, one important feature of digital broadcasting, however, is that a plurality of information such as audio, video and data can be multiplexed and sent as one transmission stream. Utilizing multiplexed data therefore means that various features can be provided.

SUMMARY OF THE INVENTION

In view of the above problems, it is therefore an object of this invention to provide a digital broadcast receiver for identifying video signal scanning methods utilizing different kinds of multiplexed information, and using such identification for selecting an appropriate scanning method for reproduction.

In order to achieve the above, this invention is directed to a digital broadcast receiver unit for receiving a digital multiplexed signal stream having multiplexed signals commonly encoded using a same encoding/decoding standard, the multiplexed signals including video signals corresponding to a plurality of different video signal formats, and isolating and reproducing at least one video signal, the unit including: a selector to select and extract one video signal from a received the digital multiplexed signal; a decoder to decode the video signal from the selector according to the encoding/decoding standard; a plurality of video processor sections, with respective video processor sections providing video processing according to a different video signal format of the plurality of different video signal formats; and a controller using information from the received the digital multiplexed signal to determine a video signal format of the video signal from the decoder, and selecting one video processor section of the video processor sections to perform video processing of the video signal according to a determined video signal format thereof. More particularly, the present invention determines the scanning method of the video signal of the selected program and then performs the appropriate processing based on the scanning method for the selected video signal.

The foregoing and a better understanding of the present invention will become apparent from the following detailed description of the preferred embodiments and claims when read in connection with the accompanying drawings, all forming a part of the disclosure hereof this invention. While the foregoing and following written and illustrated disclosure focuses on disclosing embodiments of the invention which are considered preferred embodiments, it should be clearly understood that the same is by way of illustration and example only and is not to be taken by way of limitation, the spirit and scope of the present invention being limited only by the terms of the appended claims.

BRIEF DESCRIPTION OF THE DRAWING(S)

The following represents brief descriptions of the drawings, wherein:

FIG. **1** shows a block diagram of the first embodiment of this invention;

FIGS. **2**A–C are drawings showing exemplary configurations of the digital multiplex stream;

FIG. **3** is a block diagram showing the configuration of a second embodiment of this invention;

FIGS. **4**A–B are drawings showing the configuration of a digital multiplex stream, and a flowchart showing scanning information packet processing, respectively;

FIG. **5** is a block diagram showing the configuration of a third embodiment of this invention;

FIG. **6** is a block diagram showing the configuration of a fourth embodiment of this invention;

FIG. **7** is a block diagram showing the configuration of a fifth embodiment of this invention;

FIG. **8** is a block diagram showing the configuration of a sixth embodiment of this invention;

FIG. **9** shows a different block diagram showing of this invention;

FIG. **10** shows an another different block diagram showing of this invention; and

FIG. **11** is a flowchart indicative of exemplary processing operations conducted by an application specific integrated circuit (ASIC) or central processing unit (CPU) with respect to the present invention, e.g., via suitable programming.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

Before beginning a detailed description of the subject invention, mention of the following is in order. When appropriate, like reference numerals and characters are used to designate identical, corresponding or similar components in differing figure drawings.

Hereafter, the embodiment of this inventions will be explained while referring to the accompanying drawings. FIG. **1** is a block diagram showing the structure of the digital broadcast receiver of this invention. An RF carrier wave sent from a communications satellite (not shown) is received at an antenna **1** and then processed by other components. More particularly, in FIG. **1**, the numeral **1** denotes the antenna, the numeral **2** is a tuning-demodulation means, the numeral **3** is an error correction means, the numeral **5** is a multiplex isolation means for treating a multiplexed signal, the

numeral **6** is a control CPU, the numeral **11** is an MPEG decoder for decoding the coded audio and video information. Also in FIG. **1**, the numeral **12** is an OSD (On Screen Display) circuit for adding character information to video signals output from the Moving Picture Experts Group (MPEG) decoder **11**, the numeral **13** is a D/A converter for converting digital audio signals into analog signals. Further, in FIG. **1**, the numeral **141** is a video encoder, for instance, to convert 525 interlaced scanning lines of an NTSC system signal into an analog signal and add synchronizing information, etc. The numeral **142** is a video encoder, for instance, to convert 525 scanning lines of a sequential scanning 525 progressive signal (hereafter abbreviated to 525P signal) into an analog signal and add synchronizing information, etc. The numeral **143** is a video encoder, for instance, to convert the 1080 interlaced scanning lines of an HDTV system signal into an analog signal and add synchronizing information, etc. The numeral **15** in the same figure is a video signal output terminal, the numeral **16** is an audio signal output terminal, and the numeral **27** is an output selection means.

The signal received by the antenna **1** is tuned and demodulated by the tuning-demodulation means **2**. The demodulated signal from the tuning-demodulation means **2** is output to the error correction means **3**. Error correction based on the addition of an error correction code is then performed by the error correction means **3**. Next, according to control provided by the CPU **6**, a signal of a program for viewing is demultiplexed (isolated from the other signals) and output by the multiplex isolation means **5**.

The coded audio data and coded video data isolated by the multiplex isolation means **5** is applied to the MPEG decoder **11**. The MPEG decoder **11** decodes the coded data into the digital signal that was present prior to MPEG coding, i.e., according to control provided by the CPU **6**. The digital video signal output from the MPEG decoder **11** is applied to the OSD means **12** which adds character information according to control by the CPU **6**, and is sent to the video encoders **141**, **142** and **143** which each convert the digital video signal into an analog video signal, again, according to control by the CPU **6**. As a parallel operation, the digital audio signal output from the MPEG decoder **11** is applied to the D/A converter **13**, and converted to an analog audio signal. The output from the video encoders **141**, **142** and **143** is applied to the selection means **27**, wherein an appropriate one of the outputs from the video encoders **141**, **142** and **143** is selected via control by the control CPU **6**, and the selected video signal is output. This process allows the analog video signal and analog audio signal sent from the transmitting side to be played back and output in parallel to the video signal output terminal **15** and the audio signal output terminal **16**, respectively.

The operation when processing video signals for different broadcast systems was explained above. FIG. **2**A shows the structure of one unit of the multiplexed signal referred to as a transport stream packet (hereafter TS packet). The TS packet is comprised of a payload for storing data (e.g., video, audio and other info.), a header for indicating data such as identification (e.g., packet number) and/or scanning approach (e.g., NTSC, PAL, etc.) data, and an error correction check bit for performing error correction. As shown in FIG. **2**B, in a digital broadcast, multiplexing of video signals in one stream for a plurality of differing scanning methods can be performed. FIG. **2**C shows (without headers and error correction check bits) a state of a TS packet in the case where an NTSC signal and an HDTV signal are multiplexed as one example. As is apparent from such Fig., video signals of different scanning systems do not have to be alternately or periodically provided, but instead, can be provided in any order.

When the viewer selects the desired program from such signals, e.g., through any know remote or switch arrangement (not shown), the multiplex isolation means **5** responds thereto, and only the coded audio data and the coded video data that comprises the selected program is isolated and output from the multiplex isolation means **5**. The coded video data and coded audio data which is output is applied to the MPEG decoder **11**. The coded video data includes data detailing the scanning method. The MPEG decoder **11** detects the data detailing the scanning method from the input coded data and conveys this data to the control CPU **6**. Based on the information conveyed from the MPEG decoder **11**, and the determination of the present scanning method, the CPU **6** (via suitable software programming) controls the video encoders **141**, **142** and **143**, as well as control of the selection means **27**. Thus, only the video encoder matching the video signal selected from among the video encoders **141**, **142** and **143** is utilized and an analog video signal is output from the selection means **27**.

As explained previously, operation of the video encoders **141**, **142** and **143** based on information on the scanning method detected by the MPEG decoder **11** of this invention and the selection means **27** not only allows processing and output of the signal for the correct scanning method, but also allows shutting off of the power to video encoders not currently needed and to stop their operation so that useless expenditure of unnecessary power and generation of unnecessary heat is prevented. Further, the generation of signal interference is also reduced.

Additionally, although in FIG. **1** there is illustrated a configuration in which a signal having a system corresponding to each of the video encoders **141**, **142** and **143** is inputted, it may also be applicable that signals of all the types of scanning systems are connected in common from the same terminal to the video encoders **141**, **142** and **143** as shown in FIG. **9** (implemented a self-contained unit **900**, e.g., a set-top box), and thereby the controlling CPU **6** controls in such a way that only the circuit coinciding with the scanning system of an input signal in the video encoders **141**, **142** and **143** is operated. In addition, as shown in FIG. **10** (implemented as a self-contained unit **1000**, e.g., set-top box), a signal output terminal of each of the scanning systems is connected to the switch **27'** so that the switch **27'** is controlled by the controlling CPU **6**, whereby an output terminal of the OSD means **12** coinciding with a video scanning system of a selected TV program is selected, and the signal is inputted to the video encoder. Concurrently, only the video encoder corresponding to the inputted video signal may be allowed to operate under the control of the CPU **6**. As described above, either configuration shown in FIGS. **9** and **10** provides an effect similar to that exhibited by the configuration shown in FIG. **1**.

The second embodiment of this invention is next explained while referring to FIG. **3**. Reference numeral **14** in FIG. **3** denotes a video encoder. The embodiment of FIG. **3**. differs from the embodiment of FIG. **1** in that the configuration of the video encoder **14** is a singular circuit, e.g., a sub-processor, etc., which versatilely permits processing of any of the NTSC signals, 525 signals or HDTV signals. More particularly, the video encoder **14** can be provided as a sub-processor or singular application specific-integrated circuit (ASIC) chip, having segregated processing subprograms or processing areas which can be selectively enabled/disabled to permit processing according to an

appropriate scanning method. While the FIG. **1** approach of separately provided encoders has the power saving advantage that unneeded encoders can be powered down, a FIG. **3** software implemented approach has the advantage that the encoder **14** can be easily changed/customized via simple software reprogramming. The control CPU **6** operates the video encoder **14** so as to match the scanning method detected by the MPEG decoder **11** with any of the three previously related processing means based on information conveyed from the MPEG decoder **11**.

More specifically, for instance, video filter parameters which limit the available video band are regulated. In addition, in FIG. **3**, the video encoder **14** may be constructed to have a configuration where a parameter is fixed in such a way that it may be adapted only for a predetermined kind of video signal. Alternatively, the parameter may be constructed to have a configuration that it is not fixed by the video encoder **14** by itself, but an optional value is selected by the controlling CPU **6**. For the configuration when the fixed parameter is selected, it is possible to simplify the control to be carried out by the controlling CPU. In the case of the configuration in which an optional value is selected by the controlling CPU **6**, it is possible to cope with video signals of all known scanning systems. With such an arrangement as above, the video signal inputted to the video encoder **14** is correctly encoded and outputted from the output terminal **15** as an analog video signal. This process allows the signals input to the video encoder **14** to be sent from the output terminal **15** as correctly encoded analog video signals. As explained above, processing of signals for the correct scanning method can be performed since this invention controls the video encoder **14** according to the appropriate scanning method, based on information on the scanning method detected by the MPEG decoder **11**.

The embodiments in FIGS. **1** and **3** showed examples of detection with an MPEG decoder **11** of scanning method data containing coded image data. However, as shown for example in FIG. **4**A, when there is a TS packet holding data showing the scanning method for each video signal in the payload, the data in the TS packet listing the scanning methods can be isolated by means of the above multiplex isolation means **5**, and conveyed to the control CPU **6** for subsequent use in control of the selection means **27** and the video encoder. A flowchart of this process is shown in FIG. **4**B. Even in this case, the results will clearly be the same as when detecting the scanning method with the MPEG decoder **11**.

The third embodiment of this invention is shown in FIG. **5**. The embodiment of FIG. **5** differs from the embodiment of FIG. **1** for instance, in that a signal transmission means **24** is provided for sending a signal to a television receiver, e.g., an infrared signal. This signal transmission means **24** sends an infrared signal derived from information from the MPEG decoder **11**, and such infrared signal contains information indicating the scanning method of the video signal. This arrangement for instance allows the scanning method of the video signal detected by the MPEG decoder **11** to be conveyed to a television receiver **25** having a means to receive the aforementioned infrared signal and also able to handle a plurality of scanning methods (e.g., a multi-sync or multi-scan capable television receiver), when this television receiver **25** is connected to the video signal output terminal **15**. The scanning method of the video signal for the television receiver **25** is therefore switched to match the scanning method output from the video signal output terminal **15** so that a viewer need not provide and/or manually manipulate a separate scanning method switcher.

FIG. **5** showed an example using an infrared signal as a signal transmission means **24**, however this invention is not limited to this method and an RF waveform signal sending means may also be utilized to send an RF carrier wave signal without an infrared signal. A television receiver provided with this RF waveform signal receiving capability and connected to the video signal output terminal **15** will achieve the same effect of the invention.

FIG. **6** shows the fourth embodiment of this invention. The embodiment of FIG. **6** differs from the embodiment of FIG. **5** in that rather than using a wireless signal such as infrared to show the scanning method of the video signal, an electrical signal is instead conveyed by a wire utilizing an electrical or electronic signal transmission means **26**. Using the configuration in FIG. **6** will clearly achieve the same effect of the invention as in the embodiment of FIG. **5**.

A fifth embodiment of the invention is shown in FIG. **7**. The embodiment of FIG. **7** differs from the embodiment of FIG. **1** in that the digital broadcast receiver of this invention is housed in a same cabinet **700** with a display unit, or in other words, this embodiment comprises a television with an internal digital broadcast receiver unit. In FIG. **7**, the reference numeral **28** denotes a display signal processing means, **29** denotes an audio signal processing means, **30** denotes a display means such as a CRT or liquid crystal display panel or a plasma display panel, and **31** denotes an audio signal output means such as a speaker. In FIG. **7**, the display processing means **28** and the display means **30** are configured, for example, so that an NTSC signal, a 525P signal or a HDTV signal can be displayed. Also in FIG. **7**, the control CPU **6** detects the video signal scanning method that was selected, operates the video encoders **141**, **142** and **143** and along with switching the selection means **27**, controls the display processing means **28** and functions to allow processing of video signal scanning method that was detected. This arrangement permits correct processing of the video signal for the program selected by the equipment comprising a television with an internal digital broadcast receiver unit and display of the program by means of the display means **30**.

The sixth embodiment of this invention is shown in FIG. **8** (implemented as a self-contained unit **800**, e.g., set-top box). FIG. **1** shows a configuration in which the selector means **27** selects and issues an output from the video encoders **141**, **142** and **143**. As shown in FIG. **8**, however, the sixth embodiment differs in that the selection means **27** is not used and the output from the video encoders **141**, **142** and **143** are respectively output from separate output terminals **151**, **152** and **153**. Using the configuration in FIG. **8** will clearly achieve the same effect of the invention as in the embodiment of FIG. **1**.

FIG. **11** is a flowchart indicative of exemplary processing operations conducted by the CPU **6** with respect to the present invention, e.g., via suitable programming. Such operations are repetitively performed over time.

In the above explanation, the RF carrier wave received by the antenna **1** was sent from an artificial satellite however needless to say, this invention is also applicable in cases where the RF carrier wave is sent from an antenna installed on a ground device. Further, the above explanation described an example of digital broadcast receiver compatible with the three scanning methods consisting of an NTSC signal, a 525P signal and an HDTV signal. However the same effect of the invention can be obtained with a configuration in which other video signal scanning methods are handled by a compatible MPEG encoder or video encoder. Further, as

technology advances further approaches/methods applicable for use with the present invention will be found.

In the digital broadcast receiver of this invention as explained above therefore, video signals can be correctly played back and output even when a plurality of video signals of different scanning methods are received as multiplexed signals in one stream.

This concludes the description of the preferred embodiments. Although the present invention has been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention. More particularly, reasonable variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the foregoing disclosure, the drawings and the appended claims without departing from the spirit of the invention. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. A digital broadcast receiver unit for receiving a digital multiplexed signal stream having multiplexed signals commonly encoded using a same encoding/decoding standard, said multiplexed signals including video signals corresponding to a plurality of different video signal formats, and isolating and reproducing at least one video signal, said unit comprising:

an isolator to isolate one video signal from a received said digital multiplexed signal;

a decoder to decode the video signal from said isolator according to said encoding/decoding standard;

a plurality of video processor sections, with respective video processor sections providing video processing according to a different video signal format of said plurality of different video signal formats; and

a controller using information from the received said digital multiplexed signal to determine a video signal format of said video signal from said decoder, and selecting one video processor section of said video processor sections to perform video processing of said video signal according to a determined video signal format thereof.

2. A unit as claimed in claim **1**, wherein said digital multiplexed signal is more specifically a packetized digital multiplexed signal with differing groups of packets relating to said different video signal formats, and wherein said isolator isolating a group of packets relating to said one video signal from a received said digital multiplexed signal, and wherein said controller controlling based on information of an isolated said group of packets.

3. A unit as claimed in claim **1**, wherein said plurality of video processor sections is more specifically a plurality of discrete video processors.

4. A unit as claimed in claim **1**, wherein said plurality of video processor sections is more specifically provided via at least one of a common application specific integrated circuit (ASIC) and a common microprocessor adapted to selectively perform processing according to any of said plurality of video processor sections.

5. A unit as claimed in claim **4**, wherein said selecting by said controller is more specifically performed by said controller selectively performing processing with respect to said one video processor section while not performing processing with respect to other ones of said video processor sections.

6. A unit as claimed in claim **1**, wherein said selecting by said controller is more specifically performed by a selector switch controlled to select any output of outputs from said video processor sections, according to said determined video signal format.

7. A unit as claimed in claim **1**, wherein said selecting by said controller is more specifically performed by a selector switch controlled to select any input signal of a plurality of input signals to said video processor sections, said plurality of input signals corresponding to said plurality of different video signal formats, respectively.

8. A unit as claimed in claim **1**, wherein said selecting by said controller is more specifically performed by said controller selectively enabling (said one video processor section) while disabling other ones of said video processor sections.

9. A unit as claimed in claim **1**, further comprising:

a video output display selector controlled by said controller and operable to receive any one of a plurality of outputs of said plurality of video processor sections so as to connect a selected output to a video output display terminal.

10. A unit as claimed in claim **1**, further comprising:

a plurality of video signal output terminals, each terminal providing connection to a differing output of said plurality of video processor sections.

11. A unit as claimed in claim **1**, wherein a scanning method of the video signal is derived from the information from the MPEG decoder and sent to a receiver as one of an infrared signal, a RF signal and an electrical signal, said signal containing information indicating the scanning method used to determine the video signal.

12. A digital broadcast receiver unit for receiving a digital multiplexed signal stream having multiplexed signals commonly encoded using a same encoding/decoding standard, said multiplexed signals including digitally converted audio signals, different kinds of information and video signals corresponding to a plurality of video signal scanning methods, and for isolating and reproducing at least one signal from among said audio signals, said video signals and said different kinds of information, said unit comprising:

a demodulation means for tuning in a channel of a received signal and performing demodulation thereof;

a multiplex isolation means to isolate an audio signal, a video signal and other types of data coded from said multiplexed signals output from said demodulation means;

a decoding means to decode said audio signal and said video signal from said multiplex isolation means;

a plurality of video processing means for performing processing of said video signal from said decoding means, according to said plurality of video signal scanning methods;

an output selection means for selecting an output from said plurality of video processing means; and

a control means for determining a scanning method of said video signal of said channel, and for controlling said output selection means based on a determined said scanning method for said video signal.

13. A unit as claimed in claim **12**, wherein said scanning method is determined by analyzing information provided by said decoding means.

14. A unit as claimed in claim **12**, wherein said control means operates based on information isolated with said multiplex isolation means, such information being used for determining said scanning method of said channel.

15. A unit as claimed in claim 12, wherein signals according to said plurality of video signal scanning methods are output from a common output terminal.

16. A unit as claimed in claim 12, wherein signals according to said plurality of video signal scanning methods are sent from respective different output terminals.

17. A unit as claimed in claim 12, wherein an optical signal output means is provided to output an optical signal containing information designating a determined said scanning method of said video signal for said channel.

18. A unit as claimed in claim 12, wherein an electrical signal output means is provided to output an electrical signal containing information designating a determined said scanning method of said video signal for said channel.

19. A unit as claimed in claim 12, wherein a radio frequency signal output means is provided to output a radio frequency signal containing information designating a determined said scanning method of said video signal for said channel.

20. A unit as claimed in claim 12, further comprising a display means operable according to said plurality of video signal scanning methods, and wherein said control means switches a video signal scanning method for said display means based on a determined said scanning method of said video signal for said channel.

21. A unit as claimed in claim 12, wherein said control means is capable of stopping total or partial operation of said plurality of video processing means.

22. A unit as claimed in claim 12, wherein said output selection means is operable to receive any one of a plurality of outputs of said plurality of video processing means so as to connect a selected said output to a video output display terminal.

23. A unit as claimed in claim 12, wherein a scanning method of the video signal is derived from the information from the MPEG decoder and sent to a receiver as one of an infrared signal, a RF signal and an electrical signal, said signal containing information indicating the scanning method used to determine the video signal.

24. A digital broadcast receiver unit for receiving a digital multiplexed signal stream having multiplexed signals commonly encoded using a same encoding/decoding standard, said multiplexed signals including digitally converted audio signals, different kinds of information and video signals corresponding to at least two video signal scanning methods, and for isolating and reproducing at least one signal from among said audio signals, said video signals and said different kinds of information, said unit comprising:

a demodulation means for tuning in a channel of a received signal and performing demodulation thereof;

a multiplex isolation means to isolate an audio signal, a video signal and other types of data coded from said multiplexed signals output from said demodulation means;

a decoding means to decode said audio signal and said video signal from said multiplex isolation means;

a plurality of video processing means for performing processing of said video signal from said decoding means, according to said at least two video signal scanning methods;

a control means for determining a scanning method of said video signal of said channel, and for operating said plurality of video processing means based on a determined said scanning method for said video signal.

25. A unit as claimed in claim 24, further comprising:

a video output display selector controlled by said control means and operable to receive any one of a plurality of outputs of said plurality of video processing sections so as to connect a selected output to a video output display terminal.

26. A unit as claimed in claim 24, further comprising:

a plurality of video signal output terminals, each terminal providing connection to a differing output of said plurality of video processor sections.

27. A unit as claimed in claim 24, wherein a scanning method of the video signal is derived from the information from the MPEG decoder and sent to a receiver as one of an infrared signal, a RF signal and an electrical signal, said signal containing information indicating the scanning method used to determine the video signal.

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CERTIFICATE OF SERVICE

I hereby certify that I electronically filed the foregoing with the Clerk of the Court for the United States Court of Appeals for the Federal Circuit by using the appellate CM/ECF system on January 27, 2014.

I certify that all participants in the case are registered CM/ECF users and that service will be accomplished by the appellate CM/ECF system.

Dated: January 27, 2014 s/ Deanne E. Maynard

CERTIFICATE OF COMPLIANCE WITH RULE 32(a)

This brief complies with the type-volume limitation of Rule 32(a) of the Federal Rules of Appellate Procedure because it contains 13,989 words.

Dated: January 27, 2014 s/ Deanne E. Maynard

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